

SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER 1904.

GENERAL PHYSICS.

2834. *Quartz Glass.* **H. Heræus.** (Zeitschr. Instrumentenk., Beib. 19. pp. 173-176, Oct. 1, 1908. From a Paper read before the 5 International Congress für angewandte Chemie in Berlin.)—After referring to earlier attempts at the production of vitreous silica, the author describes the new method now used for the manufacture of vessels and apparatus of this material. The quartz is melted in crucibles of pure iridium, by means of large oxy-hydrogen flames in furnaces made of lime or magnesia. Large pieces of transparent rock-crystal are melted, and although they break up during heating, this only results in the presence of a few large bubbles in the resulting glass, while silica-glass melted from small pieces is full of minute bubbles. Prolonged fusion cannot remove the bubbles, since the glass remains viscous up to temperatures of $2,200^{\circ}\text{C}.$, and when these are reached it evaporates rapidly. The glass is worked by Siebert and Kühn exactly like ordinary glass, but at temperatures well over $2,000^{\circ}\text{C}.$, obtained by means of oxy-hydrogen blowpipes. The great noise and heat of these flames renders the work trying, and the quantity of oxygen consumed also contributes to the high price of the articles made of this glass. The physical and chemical properties of vitreous silica are briefly described, and an experiment is quoted showing that the "devitrification" of the surface of tubes, &c., kept for a long time at $1,300^{\circ}\text{C}.$, is due to the formation of a surface layer of silicates, from contamination of the surface from fine dust, &c. Prolonged heating of a silica tube sealed up in a platinum tube is found to have no effect on the vitreous silica. The formation of ozone near vacuum tubes of this material during the passage of the discharge is referred to, and the intensity of the phenomenon when an Arons mercury lamp made of silica is in action is described. W. Ros.

2835. *Differential Capillarimeter.* **E. Tassilly and A. Chamberland.** (Comptes Rendus, 137. pp. 645-647, Oct. 27, 1903.)—This capillarimeter consists of a biconcave cylindrical lens, to the plane edges of which are attached two flat glass plates in such a way that two tubes are formed, whose horizontal sections are segments of circles. When this is plunged into a liquid, the curvature of the lens being unequal, the liquid rises to a different height

in each, and the difference is read off by means of a microscope furnished with a scale, and capable of reading to 0.01 mm. Assuming that the heights, h , h' , reached in such tubes are given by the formulæ $h = 2T/\rho g\epsilon$ and $h' = 2T/\rho g\epsilon'$, T being the surface tension and ρ the density of the liquid, and ϵ , ϵ' being the respective distances between the plane and curved surfaces, then $h - h' = \frac{2T}{\rho g} \left(\frac{1}{\epsilon} - \frac{1}{\epsilon'} \right)$, whence $T = (h - h') g \rho / 2 \left(\frac{1}{\epsilon} - \frac{1}{\epsilon'} \right)$, or since $\left(\frac{1}{\epsilon} - \frac{1}{\epsilon'} \right)$ is constant for a given lens, the relation becomes $T = (h - h') \rho k$, where k is a constant.

W. H. St.

2836. *New Method of Determining Compressibility.* T. W. Richards and W. N. Stull. (Amer. Chem. Soc., Journ. 26. pp. 399-412, 1904. Zeitschr. Phys. Chem. 49. pp. 1-14, July 26, 1904. Abstract from No. 7 Monograph of Carnegie Institution.)—The authors describe a new method of determining compressibility, applicable to a large number of substances. For solids a wide test-tube with well-ground hollow stopper terminating in a funnel tube provided with a downwardly projecting platinum wire is used. The tube is filled with mercury, and the volume change for different pressures measured by placing it under the liquid in a Cailletet apparatus and comparing the difference in the pressures required to make and break the electrical contact between the platinum wire and the mercury, first mercury and then the test substance is in the tube. For liquids a different apparatus is used, the method and the precautions to be adopted being fully described. The compressibility of bromine, iodine, chloroform, bromoform, phosphorus, carbon tetrachloride, and water was determined compared to mercury, in most cases up to 500 or 600 atmospheres, the compressibility of glass being also obtained from the results. The average compressibilities, $(\Delta V/V)/\Delta p$, of the substances between 100 and 200 atmospheres, and at 20°, are given in the table below. Less accurate values are extrapolated for chlorine, and approximations for the heat of compression of water and mercury obtained. The values are given in "megabars" (1 megabar = 1 megadyne per sq. cm. = 0.98795 atmo.).

Iodine.....	0.000013	Bromoform	0.0000467
Bromine	0.0000574	Water	0.0000441
Chlorine, liquid	0.00011	Phosphorus	0.0000208
Carbon tetrachloride	0.0000888	Glass	0.0000281
Chloroform	0.0000881	Mercury (Amagat)	0.0000382

A manometric method for standardising gauges for high pressures is also described.

L. H. W.

2837. *Measurement of Stress by Thermal Methods, and Influence of Stress on Thermal Expansion of Metals.* E. G. Coker. (Roy. Soc. Edinburgh, Trans. 41. 2. pp. 229-250, Sept. 2, 1904.)—After quoting Kelvin's equation for the thermal effect of stress, the author proceeds to deduce a simple equation for the special case of pure tension and pure compression. The formula at which he arrives shows that for most metals a compression stress will raise the temperature, while a tension stress will lower it. Before the formula can be submitted to experimental tests it becomes necessary to determine the effect of stress on the coefficient of expansion of metals, since this enters into the fundamental equation. This effect was determined for brass and steel under tension. The metals are used in the form of seamless tubes, kept at a known temperature by a rapid stream of warm water circulated through the bore of

the tube, the outside of the tube being well lagged. The tubes are fixed in a testing machine, and their elongation determined by means of a Ewing extensometer. As a result it is found that there is practically no difference in the linear expansion of brass and steel for any stress up to the yield point; beyond the yield point there is an increase in the coefficient of expansion of brass but not of steel. Measurements of the thermal effects of stress were made by means of a delicate thermopile connected to a d'Arsonval galvanometer. The corrections for the effects of radiation and conduction, as well as for the lag of the galvanometer, were calculated from the rate at which the deflection of the galvanometer fell off after the load had been applied. As a result it appears probable that the thermal change is very nearly proportional to the stress in the same way as the strain, and for the material experimented upon, both in tension and compression, there appears to be no range of imperfect elasticity as measured by thermal change, coinciding with a part of the range of perfect elasticity as determined by strain. The thermal method of measuring stress is finally applied to the determination of the variations of stress at different parts of a column and in the cross-section of a beam. An experiment was also made in the use of the radio-micrometer of Boys for the measurement of these thermal effects, but the extreme delicacy of the apparatus was found to render it less convenient than the thermopile for this purpose. W. Ros.

2838. *On General Mechanics and Electric Mechanics.* P. Duhem. (Journ. de Physique, 2, pp. 686-689, Sept., 1903.)—The discussion in this paper was suggested by Bouty's researches on the dielectric cohesion of gases [see Abstracts Nos. 966 and 967 (1904)]. The writer supposes a system depending only on absolute temperature and on a "variable normal" x , and subject to an external force X_x . If F be the internal potential $X_x = -(dF/dx)$ is the internal action, and $X = X_x + X_e$ the total action. D'Alembert's principle gives $X + J = 0$, in which J stands for inertia. But this, as already shown by Rayleigh and others, does not suffice to deduce the equations required. We must therefore substitute for it (1) $X + J + f = 0$, f being the action of viscosity. The writer has already proposed a further modification—

$$(2) \quad X + J + f + \frac{x'}{(\dot{x})} F = 0,$$

in which F is the action of friction, x' is the velocity relative to x , and $(\dot{x})$ the absolute value of x' irrespective of sign. This formula (2) applies, he says, to the explanation of many phenomena. Applied to the mechanics of change of state, it gives the laws of "false chemical equilibrium," explained as equilibrium due to quasi-friction in works referred to in a note, and he refers to works of his own in which is pointed out the existence of analogous cases of false equilibrium in pure physical changes, such as vapourisation, and he has shown that certain views of Tammann concerning fusion may be interpreted thereby. He comes next to the electric application. In a conducting medium we have in general (3) $X + E_x - \rho u = 0$, in which X is the x component of electrostatic force, E_x that of induction, u the component of flux, and ρ the specific resistance. The analogy between E_x and inertia, as also between $-\rho u$ and viscosity, has been pointed out by Helmholtz and others. For this equation (3) he proposes to substitute, as in the case (2)—

$$(4) \quad X + E_x - \rho u \pm \phi u / (u) = 0,$$

in which ϕ is defined as "electric friction," and the $+$ or $-$ sign is taken

according as u is positive or negative. In all cases in which the inequation $-\phi \leq X \leq \phi$ holds we have electric equilibrium. This is analogous to the law which regulates the equilibrium due to friction and false chemical equilibrium. In true conductors ϕ is zero or very small. On the other hand, in gases according to Bouty, ϕ may be considerable, and we may have false electric equilibrium. S. H. B.

2839. *Kite Observations off the West Coast of Scotland, 1902.* W. N. Shaw and W. H. Dines. (Roy. Soc., Phil. Trans. 202, pp. 128-141, Oct. 24, 1908.)—The work was undertaken by Committees of the Roy. Meteor. Soc. and of the Brit. Assoc., and the experiments were made by Dines and his two sons from a tug, steaming at 7 knots, off Crinan Bay, in generally unfavourable weather (mostly too calm, occasionally stormy). From June to August seventy-one ascents were made, the following maximum heights being reached with one, two, three, four kites: 1,676, 2,804, 3,790, 4,500 (or more) m. Height, temperature, and humidity were recorded by three pens on the drum of one instrument from Richard Frères. The hair hygrometer is not reliable for kite flights over the sea, and there may have been condensation on the instrument and wire while the kite was descending. The temperature on Ben Nevis was about 2.6°C . (up to 5.5°C .) colder than over the sea, and the clouds over the sea were apparently higher, at 1,220 m., e.g., while at 760 over the Jura Paps. The average temperature fall was 8° for the first 500 m., 2.8° for the next up to 1,000 m., and 2.2 , 2.0 , and 2.0°C . for the following stages of 500 m. up to 2,500 m. in July, and nearly the same in August. The steep gradients sometimes observed in the first 500 m. are uncertain; the air in depressions seems to be comparatively warmer. The daily temperature range off Crinan is very small. [See also Abstract No. 1272 (1904).] H. B.

2840. *Circulation in Cyclones and Anticyclones, and Forecasting by Auxiliary Charts on the 3,500- and 10,000-Foot Planes.* F. H. Bigelow. (Monthly Weather Rev. 32, pp. 212-216, May, 1904.)—Since December, 1902, daily barometric charts have been prepared for the United States on the sea-level, the 3,500-ft., and the 10,000-ft. planes [see Abstract No. 966 (1903)], and the author studies the charts for February 8 and February 27, 1903. The number of closed isobars steadily diminishes with the height. In winter they are confined to the lower strata, and are obliterated by the general eastward drift. In summer the cyclonic structures can still be found on the 10,000-ft. level, in hurricanes 5 and 6 miles above the surface; but closed isobars of low pressure never reverse into closed isobars of high pressure. As the cyclonic circulation has an inward component at the surface, this component must exist at all levels, and there can be no outward component. The warm and cold areas are located between the centres of gyration, and not at them; currents of air stream continuously through cyclones and anticyclones, so that the circulation involves fresh masses and not a cyclic return of the same mass. These conclusions are more or less in contradiction to the views of Ferrel, Oberbeck, Hann, Hildebrandsson, Bjerknes, Meinardus, and Shaw, as is briefly indicated. As the weather types are fewer in number and simpler in form on the higher planes, the author shows how these charts could be utilised for forecasting in the United States. H. B.

2841. *Behaviour of the Short-period Atmospheric Pressure Variation over the Earth's Surface.* N. Lockyer and W. J. S. Lockyer. (Roy. Soc., Proc.

78. pp. 457-470, June 22, 1904.)—In continuation of their researches [see Abstracts Nos. 198, 291, 874 (1908)] the authors give a map on which the districts are marked as + if agreeing in their general pressure curve with India, as - if agreeing with Cordoba (Argentina), and as ($\pm$?) in doubtful cases; Western Europe is of the ($\pm$?) type, for instance. The sources from which the data are taken are reproduced; W. Moss and T. F. Connolly assisted in the computations. Two neutral lines of separation can be drawn: the one neutral line separates Alaska from Siberia, runs east along the 60° of latitude, then between Greenland and Canada across the Atlantic north of the Azores, and skirting Portugal, cuts off North-west Africa, which it leaves near the Gold Coast. The other line passes north-east of Greenland and Iceland, and runs across Southern Scandinavia and Russia, then east between Tibet and Mongolia to the Yellow Sea, reappearing east of the Philippines, skirting Eastern Australia, and coming out between Tasmania and New Zealand. Thus Southern Europe and Asia, Africa and Australia, lie in the + zone. But while the pressure curve of Sydney (Nova Scotia) followed India in the period 1875-1881, it agreed with Cordoba in 1882-1890; the inverse holds for Adelaide (Australia). Attention is drawn to the pressure relations between Hildebrandsson's chief centres of atmospheric action, to Hann and to Bigelow, and finally to J. Eliot; the great drought of 1895-1902 embraced the whole Indo-Oceanic countries, comprising Abyssinia, East Africa, Afghanistan, and Australia, and all these countries lie in the + zone. This short-period pressure variation should hence help us in seasonal forecasts.

H. B.

2842. *Deflection of the Mississippi*. I. Bowman. (Science, 20. pp. 278-277, Aug. 26, 1904.)—The deflection of river courses by the rotation of the earth has been discussed more theoretically than by actual measurements. Under the direction of W. M. Davis the set of survey maps published by the Mississippi River Commission of 1888 and 1896 have been studied at Harvard. The mapped portion lies between Rosedale and Bayou Goula Bend, and comprises Vicksburg and Natchez. The author distinguishes between bends, curves whose lateral changes involve a decrease of radius, meanders where the radius increases, and reaches or relatively straight stretches. These reaches are difficult for navigation, and they are shortened as the meanders develop. Compiling statistics on bank cutting, bar cutting, and island cutting on the right or left, the author finds that the Mississippi wears its channel about as much on the one side as on the other. Yet he believes in deflections which the prevailing wind waves would conceal. In some parts the bluff on the left bank prevents deviations to that side. The author found no evidence of deflection in the rivers of Long Island, and he is, in conjunction with M. S. W. Jefferson, examining the River Rouge in Michigan, which flows east-west through plains.

H. B.

2843. *Spectroscopic Observations of Comet Borrelly (1908c)*. H. Deslandres. (Comptes Rendus, 187. pp. 398-397, Aug. 17, 1908.)—The spectrum of the comet Borrelly was observed on August 5, 6, 7 with the large equatorial at Meudon, the visual observations in the luminous region being supplemented by photographs of the blue and violet parts, obtained with a spectrograph containing one light flint prism. The time of exposure was 2 hours, with the slit directed to pass through the nucleus, mantle, and tail. The examination of the spectrum indicated the presence of the carbon bands usually attributed to hydrocarbon or cyanogen, and various supplementary rays, chiefly weak,

which appeared specially near the nucleus, superposed on a weak continuous spectrum. All the wave-lengths of the lines measured are tabulated, showing their relative intensity and probable origin. The spectrum in general is described as almost identical with that of the comet Rordame (1898b). Considerable importance is attached to the fact of the spectrum lines on the photographs appearing inclined, thus indicating some relative movement in the different regions of the cometary mass. As the slit was purposely set parallel to the tail extension, this can only be explained as being due to the varying strength of the repulsive force exerted by the sun, but more evidence is necessary for detailed determinations. A distinction of this motion apart from that due to any possible rotation of the comet could be obtained by supplementary photographs of the spectrum with the slit adjusted perpendicular to the direction of the tail. C. P. B.

REFERENCES.

2844. *Precision Balance for a Load of 25 kg.* H. Stadthagen. (Zeitschr. Instrumentenk. 23. pp. 270-274, Sept., 1903.)—The balance is made of partinium, and is described, with illustration. The sensitiveness with 20 kg. in the pan is 0.24 division of the scale for 1 m.gm. A weight of 20 kg. can thus be determined to within ± 1 m.gm. (mean error), the accuracy of weighing being to within 5×10^{-4} . L. H. W.

2845. *New Principle for the Vertical Seismometer.* T. Tamaru. (Phys. Zeitschr. 4. pp. 637-640, Sept. 15, 1903. In part read before the II. Internation. Seismolog. Konferenz, Strassburg.)—The horizontal pendulum system, now in use in Japan, is suspended by a long spring which may be assumed to remain vertical in all positions of the system. Its equilibrium may become unstable, however, and the author, therefore, proposed at Tokyo in 1901 to apply two springs with one or also with two pendulums. The problems are dealt with mathematically. The recording device could be combined with the system; if magnification is required, it would have itself to be suspended in the same way. An instrument of this type has been constructed in Göttingen. H. B.

2846. *Flow of Steam.* P. Emden. (Beibl. Ann. d. Physik, 28. 1. pp. 7-8, 1904.)—R. Emden's method of investigation [see Abstract No. 1836 (1899)] is here applied to steam, which, whether saturated or superheated, is found to behave just like ordinary gases. The critical pressure for saturated steam is 1.81 atmospheres. The shape of the issuing jet is unaffected by that of an expanding nozzle which is not filled by it, and there is no indication of a contracted vein. R. E. B.

2847. *Equilibrium of an Isotropic Elastic Plate.* J. Dougall. (Roy. Soc. Edinburgh, Trans. 41. 8. pp. 129-228, Aug. 5, 1904.)—An analytical discussion unsuitable for abstracting.

2848. *Natural Philosophy and the Aims of Modern Technical Mechanics.* A. Sommerfeld. (Phys. Zeitschr. 4. pp. 773-782, Oct. 24, 1903. Paper read before the Naturforscherversammlung, at Kassel, Sept. 20-26, 1903.)—The author pleads for verification of the fundamental experiments and for exact theoretical methods, and refers particularly to Hooke's law, the gliding motion of earth on earth (Müller-Breslau), the strength of materials and elasticity (Castigliano, Hertz, Kelvin), balancing of engines (Schlick), torsional vibrations and resonance (Frahm), the flow of liquids (O. Reynolds), and journal friction (Stribeck). A literature list is added to the paper. H. B.

2849. *Time, Effort, Space.* R. de Saussure. (Archives des Sciences, 18. pp. 221-240, Sept., 1904.)—A theory of dimensions in which the above are taken as the basis [see Abstract No. 231 (1904)]. J. W. P.

2850. *Relative Humidity at Tarnopol.* L. Satke. (Acad. Sci. Cracovie, Bull. 8. pp. 629-632, Oct., 1903.)—Summary of the results of observations from the period 1861 to 1900, and particularly 1893 to 1900 [see Abstract No. 488 (1904)]. The high mean annual value of 82 per cent. is due to the nearness of a pond surrounded by swamps. In the driest month, May, the humidity is still 70·7 per cent. H. B.

2851. *Air-Pressure Variations of very Short Periods.* M. Toepler. (Ann. d. Physik, 12. 4. pp. 787-804, Oct., 1903. Phys. Inst. d. Techn. Hochschule, Dresden, July 17, 1903.)—The author has made his variometer self-recording. From an air vessel of glass, packed with bad conductors of heat, start two tubes, a capillary tube to equalise slow barometric variations, and a glass tube bent under a very obtuse angle and containing a thread of toluol, whose meniscus is photographed on a tape. The author discusses the theory of the instrument and reproduces photographic records obtained in the Institute building; he has not yet taken many observations. The curves show, in addition to the very sharp needle points, due probably to vibrations of the walls and roof, frequently some oscillations of a period of 8 or 10 sec. which seem to be caused by a kind of air seiche, produced in the large square of the Institute garden, which is surrounded by high houses. Undisturbed waves are obtained before and after heavy winds. Making allowance for disturbances, there remain certain oscillations, steady often for hours, for which the author suggests the term "barometric unrest." The slow barometric changes only affect this unrest when it is very small; the unrest was equivalent to 0·3 mm. of mercury per min. in autumn, and changed little with capillary tubes of different diameters. Thunderstorms give characteristic curves. H. B.

2852. *Polarisation of the Sky at Twilight.* G. Sack. (Beibl. Ann. d. Physik, 28. 19. pp. 1033-1034, 1904.)—Observing the sky, after the volcanic eruptions in the West Indies, both in the mornings and evenings on 59 days after September, 1902, the author finds that the distance from the sun of Babinet's point increased extraordinarily, while the distance of Arago's point from the anti-sun decreased; the latter is not in accord with previous observations. He would formulate Busch's law of 1886 concerning the course of these points as follows: The distance of Babinet's point from the sun increases to a maximum as the sun rises to a certain small elevation above the horizon, and decreases afterwards; the distance of Arago's point from the anti-sun decreases until the sun has reached a position a little below the horizon, and increases afterwards. H. B.

2853. *Air-Bubble Levels and Temperature Variations.* G. Bigourdan. (Comptes Rendus, 139. pp. 385-387, Aug. 8, 1904.)—The author points out that air-bubble levels, used for determining the inclination of the axes of astronomical instruments, are not trustworthy if provided with the ordinary metallic mounting, owing to the unequal expansion of the glass and metal; nickel-steel mountings should be applied. H. B.

2854. *Cold Current System of the Pacific.* S. E. Bishop. (Science, 20. pp. 338-340, Sept. 9, 1904.)—The author argues that a cold current from the Antarctic creeps up, in the depth, northward, gaining in strength as it is narrowed; it is deflected east by the rotation of the earth, and strikes the coast of North-West America about Sitka and Vancouver Islands. The current then flows south along the coast down to California, producing the cold sea mists, and turns westward towards the Hawaiian Islands, where the author resides. H. B.

2855. *Blue Colour of the Sky.* **W. Spring.** (Revue Scientif. 2. p. 311, Sept. 3, 1904. Bulletin de la Société Astronomique de France, p. 101, Feb., 1904, after "Ciel et Terre.")—The author criticises Rayleigh's theory and, referring to Soret, Pernter, and Hagenbach, declares that the presence of oxygen—and further of ozone, &c.—in the atmosphere would suffice to produce a blue sky, for which turbidity alone cannot account. H. B.

2856. *Mechanics of the Universe.* **K. Schwarzschild.** (Phys. Zeitschr. 4. pp. 765-773; Discussion pp. 789-794, Oct. 24, 1903. Papers read before the Naturforscherversammlung at Kassel, Sept. 20-26, 1903.)—The author deals with the validity of Newton's gravitation law, which he considers as unshaken, and with the determination of the orbits of the planets, libration, and the stability of the solar system. While rejecting Poincaré's analytical integrals, the author concludes that the solar system will remain stable for a million years, and possibly for a thousand million years. The discussion of this paper and that by A. Sommerfeld [see Abstract No. 2848 (1904)] concerned chiefly the radiation pressure of light, Poincaré's series, and the electrical character of gravitation; **Ostwald, Klein, Runge, v. Oettingen, W. Wien, Boltzmann, and Charlier** took part in the discussion. H. B.

2857. *Earthquake of July 13, 1904, in the Central Pyrenees.* **E. Marchand.** (Comptes Rendus, 189. pp. 276-277, July 25, 1904.)—The earthquake was felt in South-Eastern France and registered at Bagnères de Bigorre by the pendulum seismograph and also by the very simple cone seismograph; it began at 3.11 p.m. The photographic magnetographs of Bagnères and the Pic du Midi were thrown off their scales for half an hour. H. B.

2858. *Circulation of the Sun's Atmosphere.* **F. H. Bigelow.** (Monthly Weather Rev. 31. pp. 459-466, Oct., 1903.)—Further examination of the solar prominence frequency convinces the author that there is a general retardation in the solar rotation as we proceed from the equator towards the poles. He assumes that the equatorial regions have a period of 26.68 days—rejecting the many estimates of shorter periods—which would increase to about 30 days at the poles. He points out that any particular meridian is seen twice, first on the eastern and then on the western limb, and he finds certain indications that the sun is a binary system. A rotating mass, hot at the centre, cooling at the surface, would, according to Helmholtz and Emden, have some discontinuous, concave cylindrical surfaces, coaxial with the axis of rotation, and vortex tubes should form extending through the whole mass of the sun, right-handed in the northern hemisphere, for convective action from the equator to the poles. The sun should thus be in a polarised state, and any such rotating mass would generate Amperean currents and a magnetic field. All the stars would be magnetic spheres, and their relative magnetism would be a measure of the activity of their internal circulation [see Abstracts Nos. 1086 (1902), 198 (1903), and 1251 (1904)]. H. B.

2859. *Spectroscopic Proof of Presence of Argon in the Atmosphere.* **E. Warburg.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 40. pp. 1196-1197, July 28, 1904.)—Under the ordinary circumstances of the passage of the discharge through mixtures of gases, it is frequently impossible to detect the presence of small quantities of a gas by spectroscopic investigation. This is especially true in the case of gases which are mixed with large quantities of nitrogen. If, however, the conditions of discharge be altered, it becomes quite possible to detect very small quantities of admixed gas. In the present case the ring discharge was employed in a tube having capillary portions, and amongst other cases the argon in atmospheric air could easily be seen in the spectroscope. [This has been done by W. Ramsay some time ago, who succeeded in seeing the krypton in air, which is present in far smaller quantities than argon.] E. C. C. B.

LIGHT.

2860. Absorption of Light in Flames Coloured with Metal Vapour. J. Stscheglayew. (Ann. d. Physik, 12. 3. pp. 579-590, Sept., 1908.)—The absorption which rays of a given wave-length experience is investigated, and the Kirchhoff law that the ratio of emission to absorption is a function of the temperature only, is found not to be applicable to these circumstances. The emitting light and the absorbing light are placed in line in front of the slit of a spectrophotometer and the turnings of the nicol prism are observed. The thermoelectric method of measuring the temperatures is described. $\log i/a$ is found to be a linear function of the reciprocal of the absolute temperature of the flame, i being the intensity and a the absorption.

J. W. P.

2861. Researches on Objectives. J. Hartmann. (Zeitschr. Instrumentenk. 24. pp. 1-21, Jan.; 33-47, Feb.; and pp. 97-117, April, 1904.)—The first paper gives a very complete account of the author's experiments in testing astronomical objectives for spherical and chromatic aberration, zonal error, and astigmatism, by his method of extra-focal measurement. The method supplies a want in furnishing a quantitative test by means of which the performance of one objective can be scientifically compared with that of another as regards each of the errors in question. Earlier observers either judged the performance of an instrument in a general way by observing test objects, or confined themselves to seeking the focal length and principal points by treating the lens system as a mathematical abstraction, and neglecting more or less the effects of aberration. In this connection attention is drawn to the inaccuracy of methods depending on the position of a "sharp" image, and also to those in which a short collimator is used to replace a distant object. In essence the extra-focal method consists in ascertaining the points of intersection of a refracted ray with any two planes perpendicular to the optic axis. To isolate particular rays in a pencil proceeding from a point source, the whole objective is covered by a paper disc of its own diameter, in which small circular holes are pierced. The diameter of a hole should be $\frac{1}{16}$ to $\frac{1}{8}$ of the focal length. The course of rays through the holes after refraction can then be examined by placing a screen or a photographic plate in their path. In examining zonal error, objective screens with four holes 90° apart in each zone are employed, and several zones may be examined at the same time. Monochromatic light should be used, or the images of the holes will be elongated instead of round. In the case of a star this difficulty may sometimes be avoided by suitable choice of star and photographic plate. Thus if the objective be achromatised for visual rays, choose a star like α Orionis weak in blue rays, and a plate sensitive to yellow. Or the white light may be analysed by a prism placed either before the objective or behind the plane of measurement, and the measures can then be carried out on the images of any particular colour. In working photographically it is best to employ an objective screen with two short, parallel slits 180° apart instead of four round holes for each zone. By repeating this process for various wave-lengths the colour curve of the objective can be determined. If the colour curve could be assumed constant for all zones it would only be necessary to

find it for a single zone and to find the zonal error and astigmatism for a single wave-length. As an example, we are told that the following six exposures, occupying about an hour altogether, were found sufficient for the complete testing of a certain objective of 80 mm. aperture and 1 m. focus. (1) Two extra-focal exposures in light $\lambda = 486$. (2) Two similar exposures in light $\lambda = 579$. (3) Two exposures for the colour curve with a slit-spectroscope, zone $r = 85.5$ mm. The distance of the source from the objective was 18.889 m. in each case. The photographs were measured under a microscope and the results calculated by formulæ given in the paper. A mercury lamp is useful for monochromatic work, and Siemens' or Bremer's carbons impregnated with metallic salts are also recommended. The second article deals with the question of the best definition of focal length and with the positions of the nodal and principal points. A nodal point is found by the method familiar to astronomers of measuring the size of the image of an object of known angular extent. The following is a new and very accurate method of determining the position of the principal points by direct measurement. The microscope which serves for the measures has a stage which can be moved perpendicularly to the optic axis by means of a micrometer screw. On this stage is laid a glass scale with equal divisions. The objective to be examined is removed from the telescope and laid on the glass scale inner side downwards, so that a diameter of the objective lies along the scale and its centre over the middle of a division of the scale. If $2r$ be the true distance between two divisions of the scale, corresponding to a measured interval $2r$ forming the diameter of a zone, H the distance of the second principal point from the plane of the back rim of the objective mounting, G the distance of the focus from the second principal point, F the focal length measured from the second nodal point, then $H = \frac{r-r'}{r} G$. The quantity G is of little practical use, but since $(r-r')/r$ is always a very small fraction, F may be substituted for G without loss of accuracy. The first principal point may be found similarly by placing the objective the other way up. The conditions for the fulfilment of the sine law are next discussed, and then follow general remarks on the requirements to be satisfied by astronomical objectives. The third article treats of small compound objectives, especially those designed for photographic work. The investigation of the image has here to be extended to regions remote from the axis, and the author therefore studies the formation of oblique pencils. A cover-screen with about thirty holes is placed before a camera objective, a sensitive plate is placed in the camera within the focus, and a series of exposures are made at varying degrees of obliquity to the incident light from a distant source, the camera being rotated about a vertical pin under the objective. The series is repeated with the plate beyond the focus. The co-ordinates of the points on the plates corresponding to the holes in the cover-screen are measured, and starting from these as data the author calculates the forms of sections of an oblique pencil. His curves are similar to the curious figures obtained by Everett from theoretical considerations [see Abstract No. 1376 (1904)], practice thus corroborating theory. The concluding section contains an illustrated description of a new form of optical bench specially designed for testing objectives. Though the above tests can be carried out with simple means, a special apparatus is convenient in institutions where testing forms part of the regular work. An iron pillar supports a horizontal cross-arm cast in one piece, having at one end an expansion in the form of a sector of 120° , with a telescope 1 m. long, swinging horizontally about its

centre on two friction rollers. The other end bears rails about 1 m. long on which run two carriers, one bearing the objective under examination, the other a test object and lamp. The sector has a vernier reading to 8'. At the small end of the telescope can be inserted as desired either a micrometer, or a frame for photographic plates, or a small slit spectrograph. In front of the eyepiece is a revolving disc with coloured glasses, and a train of prisms for direct vision can also be attached. The carrier for the objective to be tested consists of a heavy iron frame, in which slides vertically a square board with the objective held in a ring, like the front of a camera. Two screws are provided for centring. The carrier for the test object is an elaborate piece of mechanism. It can be moved longitudinally by means of a micrometer screw from the eyepiece of the telescope, and can be slid transversely. The position can be read in either direction to 0.1 mm., but small differences in the distance of the object from the objective can be read to 0.001 mm. A. E.

2862. *Method of Determining the Focal Length and the Aberrations of a Photographic Objective.* R. S. Clay. (Photographic Journ. 44. pp. 189-196, July, 1904.)—The paper describes a very simple apparatus for measuring the focal length and aberrations of a compound lens. The lens rests on two V's adjustable horizontally and vertically. The V's are attached to a carriage which slides on two bars of a cradle, and the cradle rotates about a vertical axis. A rougher, home-made apparatus may be made with two horizontal boards, the V's being fixed to the upper board, which rotates upon the lower about a vertical pin inserted in one of a series of holes pierced along the middle of the boards. The principle is a combination of the two old methods of finding the nodal points by a turntable, and of using a mirror for finding the focal length of a thin lens. The light from an arc lamp passes through a small hole, furnished with cross-wires, in a screen placed near F_1 , the focus of the lens. The rays, passing through the lens, emerge parallel and then fall normally upon a plane mirror, and are reflected back to the screen. The distance of the screen is adjusted until the image of the cross-wires is sharp, when F_1 is at the principal focus. If now the lens be rotated about a vertical axis, in general the image will be displaced, and the displacement will be twice as great as when using a distant object. But when the rotation takes place about N_1 , the second nodal point, the direction of the ray F_1N_1 is fixed, and hence, owing to the peculiar property of the nodal points, the emergent parallel pencil always strikes the mirror normally, and returns without deviation, so that the image on the screen remains fixed. Thus the point N_1 may be found by trial. To measure the spherical aberration with the apparatus a beam of parallel light is thrown on the lens, and two stops are inserted in turn, which only permit the passage of marginal and of axial rays respectively. The distance s between the two positions of the screen for sharp focus in each case measures the spherical aberration. The author defines some aberration coefficients which he suggests it would be a great convenience to have marked on lenses by the makers, as a lens has frequently to be procured for a specific purpose for which freedom from certain aberrations is of great importance, while its behaviour in other respects is of comparatively small account. For instance, he defines the aplanatic coefficient by $A = s \cdot n^2/f$, where s is the above difference between focal lengths of axial and marginal rays, and n is the "f" number. In measuring astigmatism, a piece of thin zinc in which horizontal and vertical slits have been cut, is substituted for the slanting cross-wires. The lens is turned through a large angle, so that its axis produced would meet the screen at a

point at distance r from the slits. The screen is adjusted until the image of the vertical slit is sharp, and its position noted. It is then adjusted until the horizontal slit is sharp. The distance t between the two positions of the screen measures the astigmatism of the lens at that particular obliquity. The astigmatic coefficient can be defined as $T = t.f/r$. Corresponding definitions for curvature and chromatic coefficients are given. A. E.

2863. Index of Refraction of Solutions. E. van Aubel. (Comptes Rendus, 189. pp. 126-128, July 11, 1904.)—For 35 different substances in aqueous solution, Chéneveau has shown [see Abstract No. 2155 (1904)] that the influence of the dissolved substance on the value of the index of refraction of the solution is proportional to the concentration of the solution. The author has worked with other solvents than water, viz., amyl alcohol (in which lithium chloride was dissolved), propyl alcohol (as solvent for ethylene bromide), ethyl alcohol (as solvent for chloral hydrate), and toluene (also for chloral hydrate), and so far has found that Chéneveau's law does not appear to apply to non-aqueous solutions. D. H. J.

2864. Reflecting Power and Electrical Conductivity of Alloys. E. Hagen and H. Rubens. (Annal. Chim. Phys. 2. pp. 441-449, Aug., 1904.)—The relation $(100 - R) \sqrt{\kappa} = C_\lambda = K/\sqrt{\lambda}$, where R is the reflecting power for long waves, κ the electrical conductivity, λ the wave-length, and C and K constants, previously found to exist for pure metals [see Abstracts Nos. 62 and 64 (1904)] is shown by experiments on a large number of alloys, including some nickel steels, to be equally true for these. A slight deviation occurs with magnalium, but may be attributed to the determination of the conductivity and emissive power on different specimens, and is probably only apparent. Solid bismuth, which was previously the only exception to this law, has been further studied to determine whether the changes in resistivity which the metal undergoes in a magnetic field, are accompanied by a corresponding change in the emissive power, but with negative results. For alloys of bismuth in the liquid state the emissive power is quite normal. The values deduced for the constants C_λ and K are 7.29 and 36.8 respectively, which closely agree with those already obtained with pure metals, and those calculated from Maxwell's theory. W. H. Si.

2865. Refractive Index of Solutions. C. Chéneveau. (Comptes Rendus, 189. pp. 861-863, Aug. 1, 1904.)—For aqueous solutions the author has found that the quantity $\Delta = \mu - \mu_s$ is generally proportional to the concentration, where μ is the index for the solution and μ_s the index for water calculated according to its state of dilution after Gladstone's law. [See Abstract No. 2155 (1904).] E. van Aubel has endeavoured to find if this relation holds for other solvents than water, and concludes that it does not apply to solutions any more than to mixtures. [See Abstract No. 2863 (1904).] The author shows it is necessary to consider the density of the solvent. The following formula is general: $\mu_d = 1 + (\mu_1 - 1) \frac{100 - p}{100} \frac{D_1}{d}$, where μ_d is the index of the solvent in the solution, μ_1 the normal index of the solvent, D_1 the density of the solution, d that of the solvent, p the weight of the substance in 100 gm. of the solution. For different solutions $\Delta = \mu - \mu_s$ varies almost in proportion to the concentration, certainly for the solutions examined by van Aubel. For

lithium chloride, the constant $K = \Delta/C$ is the same in water and in amyl alcohol.

LITHIUM CHLORIDE.						ETHYLENE BROMIDE.	
Amyl Alcohol. (Andrews and Eude.)		Water. (Chéneveau.) (Dijken.)				Propyl Alcohol. (Schütt.)	
p	K	p	K	p	K	p	K
6.46	0.000849	16.12	0.000848	1.05	0.000846	10.01	0.000245
5.71	0.000853	13.10	0.000850	0.26	0.000844	20.95	0.000244
5.05	0.000852	9.99	0.000851	—	—	29.84	0.000244
3.40	0.000851	8.89	0.000851	—	—	40.73	0.000245
2.57	0.000854	6.77	0.000851	—	—	49.95	0.000245
1.80	0.00088	3.44	0.000352	—	—	60.09	0.000245
0.65	0.00088	—	—	—	—	70.01	0.000245
—	—	—	—	—	—	80.09	0.000245
—	—	—	—	—	—	90.19	0.000247

CHLORAL HYDRATE (Rudolphi).

Water.			Alcohol.			Toluene.		
	20.2°.	44°.		20.2°.	44°.		20.2°.	44°.
p	K	K	p	K	K	p	K	K
80	0.000801	0.000804	80	0.000802	0.000802	60	—	0.000800
50	0.000801	0.000808	50	0.000802	0.000803	40	0.000800	0.000299
20	0.000801	0.000802	20	0.000801	0.000296	20	0.000816	0.000814
10	0.000804	0.000801	10	0.000299	0.000299	10	0.000824	0.000824
5	0.000812	0.000808	5	0.000271	0.000288	5	0.000819	0.000824
2	0.00083	0.00081	2	0.00083	0.00081	2	0.00082	0.00083

F. S.

2886. *Investigation of an Optico-magnetic Phenomenon.* A. Sella. (Accad. Lincei, Atti, 13, pp. 148-156, Aug. 7, 1904.)—Majorana discovered [see Abstract No. 218 (1903)] that there exists strong double refraction in certain solutions of ferric colloidal hydrate. It occurred to the author to investigate the question whether there exists in the same liquids the reciprocal phenomenon, that is, whether as the velocity of a plane-polarised wave varies with the inclination of the ray to the field of magnetic force, there would be a corresponding variation of the magnetic permeability. Careful experiments failed to show the expected phenomenon. But Voigt has given a mathematical theorem from which the existence of the phenomenon is deduced analytically. [See Abstract No. 805 (1903).] The writer works out Voigt's mathematics, and shows that the result, although a necessary analytical result, will be very small, and its smallness accounts for the failure of the author's experiments to detect it. He points out the relation of this theory to the results obtained by Schmauss [see Abstract No. 1951 (1904)] and Kerr (Rep. Brit. Assoc. p. 88, 1901).

S. H. B.

2867. Absorption of Ultra-Violet Light in Gases. **W. M. Varley.** (Cambridge Phil. Soc., Proc. 12, pp. 510-516, Aug., 1904).—A brass vessel, 10 cm. in length and 4 cm. in diam., closed at either end by a quartz window, which served to contain the various gases, was interposed between the source of ultra-violet light and an apparatus in which the intensity of illumination was measured. The source of ultra-violet light used was a spark between iron terminals in pure, dry hydrogen. The intensity of the ultra-violet light was measured by the magnitude of the photo-electric current it produced from a zinc surface, negatively charged, situated 3 mm. behind a fine gauze, which served as the positive electrode. The values of a , the coefficient of absorption, calculated from the formula $I = I_0 e^{-at}$, where I/I_0 is the ratio of the intensity of the transmitted light to that of the light which has not passed through the absorbing medium, and t is the thickness of the medium traversed, are as given below. The values of $1/a$ are also given, this being the thickness of the medium required to reduce the intensity of the light to $\frac{1}{e}$ of its original value. The values of the coefficient refer to the gases at atmospheric pressure.

Gas.	a in cm. ⁻¹ .	$\frac{1}{a}$ in cm.
CO ₂	Very small	Very large
CO	0.0067	149
CH ₄	0.017	59
C ₂ H ₄	0.025	40
C ₂ H ₂	Very large	Very small
Coal gas	0.18	5.6
SO ₂	1.90	0.53
H ₂ S	0.28	4.2
H ₂ O (vapour)	0.62	1.6

J. J. S.

2868. Achromatisation of Approximately Monochromatic Interference Fringes by a Highly Dispersive Medium, and the consequent Increase in the Allowable Path-difference. **R. W. Wood.** (Amer. Acad., Proc. 40. 6. pp. 865-896, Sept., 1904. Phil. Mag. 8, pp. 824-830; Note by Rayleigh, pp. 830-831, Sept., 1904.)—In the experiments described in Abstract No. 2873 (1904) the author observed that the path-difference under which it is possible to obtain interference-fringes with helium (D_3) light can be more than doubled by the introduction of a small amount of sodium vapour into the path of one of the interfering beams. This development of fringes far out in the system by the dispersing action of the sodium vapour is accompanied by their complete disappearance at the centre of the system, where the difference of path is zero. If we consider the fringes produced by such a radiation as that of the D_3 helium line, consisting of a single, broad line of wave-lengths $\lambda \pm d\lambda$, then clearly an infinite number of series of very slightly differing fringe-rings will be superposed; these will all coincide at one portion of the system, producing a region of maximum distinctness. If now a column of highly dispersive vapour be introduced in the path of one of the interfering beams, i.e., a vapour whose dispersion is notably different for the wave-lengths $\lambda + d\lambda$ and $\lambda - d\lambda$, then evidently a different retardation will be set up for each of the series of fringes. In this way the region where the coincidence occurs or the region of maximum distinctness will move in the direction of longer path-

difference. It must be understood that a very small actual displacement occurs, the wandering of the system being merely a change in position of the region over which fringes can be seen. The effect of the sodium vapour upon the interference fringes obtained with white light was also observed, a similar explanation being given. In a note appended by Rayleigh, he observes that the shift is of the same nature as the displacement of the white centre, found by Airy and Stokes to follow the insertion of a thin plate of glass. If D be the thickness of this glass-plate and μ the index of refraction, then the retardation caused will be $(\mu - 1)D$, and the whole relative retardation will be $R + (\mu - 1)D$ (1) if R be the retardation due to other causes; R and D are supposed to be independent of λ . The order of the band (n) is given by $n = (R + (\mu - 1)D)/\lambda$. Now for the achromatic band with white light, or for the place of maximum distinctness with approximately homogeneous light, n must be stationary as λ varies, thus $dn/d\lambda = 0$. For a small range of wave-lengths we may write $\lambda = \lambda_0 + d\lambda$, so that—

$$n = \frac{R + \left(\mu_0 + \frac{d\mu}{d\lambda_0} d\lambda - 1\right)D}{\lambda_0 + d\lambda}$$

$$= \frac{R + (\mu_0 - 1)D}{\lambda_0} + \frac{d\lambda}{\lambda_0} \left(D \frac{d\mu}{d\lambda} - \frac{R + (\mu_0 - 1)D}{\lambda_0} \right).$$

The achromatic band occurs, not when the whole relative retardation (1) vanishes, but when $R + (\mu_0 - 1)D = D\lambda_0 d\mu/d\lambda_0$ (2). The question concerning us is one of the *group-velocity*. Approximately homogeneous light consists of a train of waves in which the amplitude and wave-length slowly vary. A local peculiarity of amplitude and wave-length travels with the *group*- and not the *wave*-velocity, and the relative retardation with which we are concerned is that of the groups. It is thus obvious that what is to be made to vanish is not (1) that in which μ is the ratio of wave-velocities V_0/V , but that derived by replacing μ by U_0/U or by V_0/U , where U is the group-velocity in the dispersing medium. Now $U = d(kV)/dk$, where k is the reciprocal of the wave-length in the medium. If λ be the wave-length in vacuo, then $k = 2\pi\mu/\lambda = 2\pi V_0/\lambda V$.

Accordingly—

$$\frac{V_0}{U} = \frac{V_0 dk}{d(kV)} = \frac{d\left(\frac{\mu}{\lambda}\right)}{d\left(\frac{1}{\lambda}\right)} = \mu - \lambda \frac{d\mu}{d\lambda}.$$

Substituting this for μ in (1), then the position of the most distinct band is given by $R + [\mu - 1 - \lambda d\mu/d\lambda]$ (1) = 0, which is agreement with (2) above.

E. C. C. B.

2869. *Photometric Experiments with Selenium*. F. Townsend. (Elect. Rev., N.Y. 45, pp. 891-894, Sept. 10, 1904. Electrician, 58, pp. 987-990, Oct. 7, 1904.)—The author first deals with the properties of selenium and the methods of making selenium resistance cells sensitive to light, baking curves being given showing the resistance at various times and various temperatures during the heating and subsequent cooling. The attempt to utilise such a cell for photometric measurement led to the devising of two methods which are stated to give good results when used to compare lights substantially similar in colour, but the results are confessedly inferior to measurements made with ordinary photometers. For measuring the illumination of a room the method is, however, accurate enough. The simpler and more rapid method con-

sists in exposing the cell to a high candle-power lamp for about 45 sec., and then allowing the galvanometer deflection to drop (cell in the dark) to some definite value. As soon as this value is reached it is exposed to the first lamp to be tested for 5 min. It is then darkened and the deflection allowed to drop to the same value, and the process repeated with the other lamps. Calibration curves for a cell obtained from such measurements are given, in which deflections are plotted as abscissæ against candle-power as ordinates. The paper is chiefly of value for the information as to the various properties of selenium. L. H. W.

2870. *Rotatory Dispersion of Solutions.* II. C. Winther. (Zeitschr. Phys. Chem. 45. pp. 331-377, Oct. 13, 1903.)—The ordinary dispersion coefficient, in so far as it is applicable at all, is noteworthy as being independent of the concentration, and the question naturally arose in the author's mind whether his "rational dispersion coefficient" (which is applicable even in cases of anomalous dispersion) is also independent of the concentration. The present paper contains the results of the investigation, in which, by the method described in Part I. [see Abstract No. 52 (1903)], the author examined solutions of diethyl tartrate in benzene and in isobutyl alcohol; dipropyl tartrate in benzene, in isobutyl alcohol, and in ethylene bromide; tartaric acid in water and in alcohol; malic acid in water. The data show that the "rational dispersion coefficient" is really independent of the concentration, and hence it must, for the same active body in solution, be independent of the solvent. It has already been shown that it is independent of the position in the homologous series (at any rate in the case of the tartaric acid series), so that it is of wide significance. The following table summarises the results in the well-investigated cases (r = red; y = yellow; g = green; lb = light blue; db = dark blue):—

	$r : y.$	$g : y.$	$lb : y.$	$db : y.$
Tartaric acid in water. Solution I.....	0.77	1.31	1.92	2.19
" " " II.....	0.80	1.32	1.95	2.26
" " " III.....	0.74	1.27	1.86	2.17
" " " IV.....	0.76	1.28	1.89	2.20
Dimethyl tartrate.....	0.75	1.31	1.89	2.26
Diethyl tartrate. Preparation I.....	0.75	1.29	1.85	2.11
" " II.....	0.76	1.27	1.89	2.12
" " in isobutyl alcohol. Solution I.....	0.78	1.27	1.89	2.14
" " " " II.....	0.78	1.30	1.91	2.11
" " " " III.....	0.80	1.28	1.91	2.12
" " " " IV.....	0.84	1.18	1.93	2.12
Dipropyl tartrate. Preparation I.....	0.78	1.29	1.83	2.19
" " II.....	0.78	1.27	1.89	2.09
" " in isobutyl alcohol. Solution I.....	0.78	1.26	1.87	2.08
" " " " II.....	0.76	1.27	1.89	2.09
" " " " III.....	0.79	1.30	1.96	2.17
" " " " IV.....	0.75	1.24	1.90	2.13
" " in ethylene bromide. " I.....	0.77	1.30	1.88	2.11
" " " " II.....	0.76	1.29	1.87	2.09
" " " " III.....	0.81	1.27	1.89	2.14

D. H. J.

2871. *Polarisation Colorimeter.* A. A. Meisling. (Zeitschr. Analyt. Chem. 43. pp. 137-146, 1904.)—The author describes an apparatus designed for a hæmoglobinometer, but it may be employed for general colorimetric

estimations. By circular polarisation a coloured field is produced, exactly matching the colour of the solution in a column the length of which can be measured. The instrument contains a pair of nicols with a quartz plate between them. Into the solution dips a tube which is closed at the bottom by a thin glass plate and can be raised or lowered by a rack. The distance between this glass plate and the bottom of the reservoir gives the length of column of liquid, and can be read on a scale. A standard solution of the substance to be estimated is first examined. The observer, looking through the upper nicol, sees then two illuminated discs, and by rotating the analyser while varying the length of the coloured solution can obtain exactly the same colour in both discs. The analyser is then clamped, and the standard solution replaced by that which is to be estimated, and by varying the length of the column the same colour is reproduced. The percentage of coloured substance is inversely proportional to the length of column required. One c.cm. of solution, containing 5 to 20 cub. mm. of blood (diluted with a 0.1 per cent. solution of sodium carbonate), suffices for the observations; the length of column varies exactly with the dilution within wide limits. L. H. W.

2872. *Use of the Diffraction Grating for the Study of Ultra-violet Spectra.* R. Magini. (Phys. Zeitschr. 4. pp. 614-615, Sept. 1, 1908. Communication from the phys. Inst. der Universität, Pisa.)—If the ordinary concave grating mounting be employed and the ultra-violet spectrum of the first order be observed, the dispersion will not be sufficient for the author's needs. The second-order spectrum will be too contaminated with other orders to be of much use. The author uses the following arrangement: The ordinary concave grating mounting is used, and to the centre of the girdle connecting the eyepiece and grating carriages is fixed an arm at right angles, which is fastened to a circular frame cut to the focal circle of the grating. A photographic film is mounted on this frame, and in this way the spectrum is photographed some way to the side of the normal to the grating. Much greater dispersion is thus gained; the wave-lengths may be found from the formula $\lambda = 2e \sin(S/4r) \cos\{i - (S/4r)\}$, where e is the grating space, S the distance between the line in question and the reflected image of the slit, $2r$ is the radius of curvature of the grating, and i the angle of incidence. E. C. C. B.

2873. *Anomalous Dispersion of Sodium Vapour in the Visible and Ultra-Violet Regions.* R. W. Wood. (Phil. Mag. 8. pp. 298-324, Sept., 1904. Phys. Zeitschr. 5 pp. 751-768, Nov. 15, 1904.)—In this interesting paper are described the methods employed for the measurement of the indices of refraction of sodium vapour. Two methods were used—first, the determination of the relative retardation caused by a column of sodium vapour for rays of different wave-lengths; and second, actual observations of the deviations produced by prisms of sodium. As has already been shown by the author, anomalous dispersion occurs at the positions of the three first members of the principal line series $\lambda = 5893$, 3303, and 2852, the most striking effect occurring at $\lambda = 5893$. The dispersion of the vapour in the neighbourhood of the D lines is enormous; waves of lengths $\lambda = 5874.87$ and 5875.13 are retarded in the ratio of 10.5 to 11, which means that if we had a prism of sodium vapour giving a deviation equal to that produced by an ordinary 60° glass prism, two lines in the spectrum separated from one another by an interval $\frac{1}{3}$ of that between the D lines would appear separated by a distance greater than the distance between the red and bluish-green of the spectrum produced by the glass prism. The

method of obtaining the two lines of wave-lengths $\lambda = 5874.87$ and 5875.18 was to split the helium D_3 line into a triplet by a magnetic field and absorb the centre component by a nicol prism. Some very interesting observations are recorded upon the physical properties of sodium vapour, notably its extraordinary viscosity; it was this last property that enabled the author to obtain a prism of sodium vapour. If an exhausted glass tube provided with plate-glass ends and containing some sodium is placed horizontally and the sodium heated by a small Bunsen flame, the sodium vapour forms a cone over the surface of the molten metal which will persist for an hour or more. This cone, when viewed through a wide horizontal slit, makes a very effective prism of sodium vapour, by means of which the refractive indices can be directly measured. For the density of the vapour Jewett's values were used [see Abstract No. 554 (1908)], the temperature being determined by means of a thermocouple. The following relative deviations were observed for the waves between the D_3 and D_2 lines:—

	Deviation.
D_3 5875	1
5881.6	2
5885	3
5886.6	5
5888.8	12
5889.6	84
D_2 5890	—

Refractive indices in the vicinity of the D lines:—

λ	n Calc.	n Obs.
5875	0.9958	0.9954
5882	0.9890	0.9908
5885	0.9880	0.9860
5886.6	0.9750	0.9770
5888.4	0.9450	0.9443
5889.6	0.697	0.614
5991	1.0046	
5904	1.0092	
5901	1.0188	
5899.4	1.0184	
5897.6	1.0557	
5897	1.994	
5896.4	1.886	

The following values were obtained:—

λ	Relative Fringe-shift.	Total Shift.	Refractive Index Obs.	Refractive Index Calcul.	λ	Relative Fringe-shift.	Total Shift.	Refractive Index Obs.	Refractive Index Calcul.
7500	2	25	1.000117		5843	33	413	0.998492	
6310	4	55	1.000197		5827	25	313	0.998362	
6300	6	75	1.000251	1.000285	5807	30	250	0.998093	
6137	7	88	1.000385		5750	11	138	0.999505	
6055	11	138	1.000523	1.00052	5700	9	113	0.999599	
6013	14	175	1.000658		5650	7.4	92	0.999650	
5977	20	250	1.000684		5460	4	50	0.999394	
5960	25	313	1.001164		5400	3.6	45	0.999341	
5942	33	413	1.001532		5300	2.9	36	0.9998807	0.999885
5916	60	750	1.002972		4500	1.4	17.5	0.9998608	0.999865
5875	100	1250	0.996410	0.9968	3610	1.09	13.6	0.999898	
5857	67	834	0.996929	0.99692	3370	0.9	11.4	0.999768	0.999687
5838	50	625	0.997711		3250	0.7	8.7	0.999677	0.999695
5820	40	500	0.998173	0.99815					

In the second and third columns of the table the results of the interference

measurements are given; in the third column the actual shifts are given which would be found for a layer of vapour 8 cm. thick. The calculated values of the indices are obtained from the formula $\mu = 1 + (m\lambda^2/\lambda_0^2 - \lambda_0^2)$, where m is a constant and λ_0 the wave-length at the centre of the absorption band. E. C. C. B.

2874. *Continuous Spectrum.* T. H. Havelock. (Cambridge Phil. Soc., Proc. 12. pp. 175-178, Oct., 1908.)—Regarding the continuous spectrum as produced by radiation constituted of an irregular sequence of impulses due to the encounters between the molecules of a gas, assuming such impulse, when it reaches the observer at time t , to be represented by $Arme^{-\mu^2 r^2/\theta^2}$, where r is the relative velocity of the colliding molecules and θ is the absolute temperature of the gas as a whole, resolving each impulse into its periodic constituents by Fourier's method, with $u/2\pi$ as type-frequency, and considering Maxwell's law of distribution of velocities to hold, the author finds that the density of total energy E of the radiation is proportional to—

$$\theta^{m-1} \int_0^\infty du \int_0^\infty dx x^{2m+1} \exp(-x^2 - a^2 u^2/\theta^2 x^2),$$

wherein a^2 is a constant. Introducing the wave-length λ or the product $k \equiv \lambda\theta$ instead of the period, we find E proportional to—

$$\theta^{m-1} \int_0^\infty dk k^{-2} \int_0^\infty dx x^{2m+1} \exp(-x^2 - c^2/4k^2 x^2),$$

which is integrable if $2m + 1$ is even, and is then of the form—

$$\theta^{m-1} \int_0^\infty dk f(k) e^{-ck},$$

where f denotes an algebraic function. With $E = \int_0^\infty E_\lambda d\lambda$, this gives $\theta^{m+1} f(k) e^{-ck}$ as the general expression for E_λ , the maximum value of which at any temperature thus occurs for the same value of k , so that the wave-length for maximum value of E_λ is inversely as the absolute temperature. Stefan's law is satisfied if $m = 4.5$. R. E. B.

2875. *Spectroscopic Method of Estimating Didymium and Erbium in Solution.* J. E. Purvis. (Cambridge Phil. Soc., Proc. 12. pp. 202-205, Oct., 1908.)—The method consists in observing the absorption spectrum of the solution, A, of unknown strength, side by side (in the same spectroscope) with that of a solution, B, of the didymium or erbium salt of known strength, contained in a tube of the same cross-section. The thickness of the absorbing layer of B is adjusted by a draw-tube arrangement till the two spectra are exactly the same in appearance. The concentrations are then inversely as the thicknesses of the absorbing layers in the two tubes respectively. For the estimation the chlorides of the metals are preferred, as there is no change in the absorption bands when the strong solutions are diluted; sharper results are obtained when the solutions are not too concentrated. D. H. J.

2876. *Absorption Spectra of very Dilute Solutions of Nitrates and Chlorides of Didymium and Erbium.* J. E. Purvis. (Cambridge Phil. Soc., Proc. 12. pp. 206-211, Oct., 1908.)—The present work deals experimentally with very dilute solutions only, and is in continuation of observations published by Liveing [see Abstract No. 1420 (1900)] on the "effects of dilution, temperature, and other circumstances on the absorption spectra of didymium and

erbium salts." The reproductions of photographs of the spectra obtained best express the results, which may be summarised thus: (1) The absorption bands of highly concentrated solutions of the chlorides of didymium and erbium are not altered when these solutions are highly diluted; (2) the absorption bands of highly concentrated solutions of the nitrates of didymium and erbium are considerably less diffuse when these solutions are highly diluted. It is noteworthy that this is an effect analogous to that produced in the spectra of some gases and vapours by diminishing the intensity of the gas or vapour; (3) the absorption bands of concentrated and diluted solutions of the chlorides of Di and Er are precisely similar to those observed in diluted solutions of the nitrates of these earths. Hence it may be suggested that the various elements which compose the molecules of Di and Er form different complex groupings with nitric acid than with hydrochloric acid, and that this complexity is broken down when the concentrated solutions are diluted.

D. H. J.

2877. *Spectra of Metallic Arcs in an Exhausted Globe.* A. Fowler and H. Payn. (Roy. Soc., Proc. 72. pp. 253-257, Oct. 19, 1903.)—The results of some observations of the spectra of the arc, between poles of Mg, Zn, Cd, and Fe in vacuo. The current employed was about 8 amps. at 100 volts. In the case of Mg the triplets at $\lambda\lambda = 5788.84$ and 8838.44 are little affected, but the lines of the special series $\lambda\lambda = 5528, 4703, 4352, 4167, 4058$, and 3987 are made sharper; four new lines of this series were observed at $\lambda\lambda = 3938, 3904, 3879$, and 3860 . The band at 5007.5 is generally reduced in intensity, while the "hydride" bands at $5618, 5210$, and 4849 appear with great intensity. The enhanced line 4481.3 is about the same intensity as b , and stronger than the lines 4703 and 4352 . Two pairs of sharp lines are also to be seen at $4385, 4391, 4428$, and 4434 , which are undoubtedly enhanced lines. The hydrogen F line is also visible, and further the flutings and enhanced lines appear to originate in different portions of the arc. Very similar results were observed, of which the details are given, in the case of Cd and Zn. In the case of iron the difference between the arc in air and that in vacuo is not so evident; the principal enhanced lines, however, appear in the latter case. The authors attribute the changes recorded to the presence of hydrogen in the globe, which is being continually evolved by the metals. E. C. C. B.

2878. *Wave-Lengths and Linear Series in the Principal Bands of the So-called Carbon Oxide Spectrum.* J. Loos. (Zeitschr. Wiss. Photog. 1. pp. 151-160, 1903. From the Bonn Dissertation, 1903.)—The spectrum was obtained from a vacuum tube containing CO_2 with a large Rowland grating. About 600 lines were measured in the principal bands at $\lambda\lambda = 5610, 5198, 4885, 4511, 4463, 4341$, and 4123 . Each band consists of four to six series, which, however, have not a common head; their heads lie very close together. Deslandres' formula, $1/\lambda = A + Bm^2$, was tested, and was not found to express the observed values well; secondly, the different series of one band start from different heads; and lastly, the term B is not constant, so that each series is not congruent. [See also next Abstract.] E. C. C. B.

2879. *Measurements and Linear Series in the Band Spectrum of Alumina.* J. Lanwartz. (Zeitschr. Wiss. Photog. 1. pp. 160-174, 1903. From the Bonn Dissertation, 1903.)—The conclusions drawn in this paper are very similar to those given by Loos from his work on the CO_2 spectrum [see preceding Abstract]. From every head four series of lines start, of which two

are stronger than the others, so that pairs are formed which may be traced up to high orders. Deslandres' formula, $1/\lambda = A + Bm^2$, was found to express the observations fairly well up to $m = 50$; at this point differences begin to appear between the observed and calculated values. These differences amount to 8 or 4 A.U. when $m = 145$. It was not possible to find whether the four series have a common head, as the heads of the bands were not resolved. It was further found that the term B of the formula is variable, showing that each series is not congruent.

E. C. C. B.

2880. *Theory of Spectral Lines. II. F. Lindemann.* (Kais. Akad. München, Ber. 38. pp. 27-100, 1903.)—This paper is a continuation of an investigation attempting to express the frequencies of spectral lines as the oscillations of an elastic mass floating in the ether. In the first part [Kais. Akad. München, Ber. 31. p. 441, 1901] the oscillations of an elastic sphere were dealt with; in the present paper the oscillating system is taken as an ellipsoid of three axes. The mathematical treatment is too complex to admit of abstraction, but the following conclusions are arrived at: Taking particularly the cases of prolate and oblate spheroids, solutions of the differential equations in the first case are possible, which permit the expression of the infinite number of oscillations in groups and subgroups corresponding to the series in band spectra. This is true for the unsymmetrical oscillations. Oscillations perfectly symmetrical to the axes of rotation are also possible, and these are considered to give rise to the principal line series. In the case of the oblate spheroid this principal series can only consist of one or very few terms. The author applies his formulæ to observed facts, and meets with certain difficulties. The equations do not give the Kayser and Runge formula, but other forms. Certain suggestions are put forward, based on the above, as to the shape of the atoms of the metals whose series relations are known.

E. C. C. B.

2881. *Wave-length of λ 508 Cadmium Line. C. Fabry.* (Astrophys. Journ. 19. pp. 116-118, March, 1904.)—The actual wave-length of this line, important on account of its having been selected as standard for an absolute length record, has been questioned by several workers, and the author shows the discrepancies to be produced according to the particular method of exciting the vacuum tube containing the cadmium. The line is double or triple according as the vacuum tube is used with or without internal electrodes, and as the components of the multiple line also vary in intensity with changes in condition, it is evident that the measurements of absolute wave-length must differ with the particular component selected. This accounts very well for the difference of 0.0784 tenth metre found by Hamy for the green ray, and shows the necessity of examining all standard light sources with high dispersion. If the structure of the line is known, however, the author considers there will be no inconvenience in retaining the cadmium green line as a secondary standard.

C. P. B.

2882. *Spectrum from a Geissler Tube in a Magnetic Field. P. Zonta.* (N. Cimento, 7. pp. 821-833, May, 1904.)—A. Trève observed in 1870 that a Geissler tube containing hydrogen lost its ordinary cherry-red colour and became yellowish or whitish under the influence of magnetism. Observation with the spectroscope showed that under magnetic influence the characteristic lines became fainter and more diffuse, and that at the same time a weak continuous spectrum developed. It has never been proved that the phenomenon is purely magnetic; indeed the author of the present paper shows (in the case

of hydrogen, chlorine, bromine, iodine, carbon tetrachloride, silicon tetrachloride and nitrogen) that it is not so, since he has obtained the same phenomenon merely by introducing a condenser. D. H. J.

2883. *Theory of Gas Spectra.* J. Stark. (Ann. d. Physik, 14. 8. pp. 506-588, July, 1904.)—If an electron is joined to an atom or molecule its acceleration will be conditioned by the material to which it is joined. The author therefore attributes to such electrons line and band spectra. A freely moving electron, on the other hand, will frequently have its acceleration changed by collisions; continuous spectra are therefore held to be due to these free electrons. If an electron of mass m collides with an atom of mass M , the energy lost is proportional to $\left(1 - \frac{m}{M+m}\right)$, if both are inelastic, and this is taken as being proportional to the energy radiated. According to the views here advanced, a change in velocity of the electrons has the same effect on the radiation emitted, whether caused by rise in temperature or the presence of an electrical field. In the latter case it is called the electrical temperature. Since the field in a Geissler tube is more intense at the kathode than the anode, the electrical temperature will be the higher near the former, and therefore the light emitted of shorter wave-length. A similar explanation is advanced for the colours on opposite sides of the striæ. The radiation from an arc and from an electric spark are also dealt with. Reasons are given for supposing that line spectra may be due entirely to atoms from which one or more electrons have been emitted, while band spectra may be due to a negative electron combined with one of these positive ions. Some experiments are given in support of the theories proposed. R. S. W.

2884. *Absorption Spectrum of p-Nitrosodimethylaniline.* W. N. Hartley. (Chem. Soc., Journ. 85. and 86. pp. 1010-1018, July, 1904.)—The results of the author's measurements are as follows: (1) The absorption caused by *p*-nitrosodimethylaniline at the less refrangible end of the spectrum extends into the infra-red, and at the more refrangible end it goes far into the ultra-violet. This restricts the transmitted rays to a continuous spectrum composed only of yellow and green light and bordered on either side by a band of intense darkness. This is characteristic of *p*-nitroso-compounds, the edge of the band in the blue shifting according to the number of hydrogens replaced and the nature of the substituted radicles. (2) There appears to be a decided difference in constitution between the quinoneoxime (*p*-nitrosophenol) and *p*-nitrosodimethylaniline, which cannot be accounted for by a substitution of 'OH' for $N(CH_3)_2$, because the widely extended and intense absorption band which belongs to quinoneoxime is, in the case of *p*-nitrosodimethylaniline and its congeners, shifted along from the ultra-violet far down into the visible region. (3) The alkyl-substituted phenols and anilines absorb varying quantities of the ultra-violet, the absorption not extending into the visible spectrum, but the introduction of the NO as distinguished from the N'OH group extends the absorption far into the coloured rays. This is a characteristic effect of the nitrosyl group, which, when it replaces hydrogen in the benzene ring, constitutes a chromogen. From this it appears to be not improbable that a solution of *p*-nitrosophenol is a mixture of two tautomeric forms. (4) Although the absorption of rays in the blue and violet by *p*-nitrosodimethylaniline is strong, there is at a certain dilution a transmission of the greater part of the ultra-violet. T. H. P.

2885. Spectroscopic Observations at very High Temperatures. R. Nasini and F. Anderlini. (*Accad. Lincei, Atti*, 18. pp. 59-66, July 17, 1904.)—The authors find that both iodine and nitrogen give real emission spectra under the influence of heat alone. The substances were heated to a very high temperature in a tube of carbon 50 cm. in length, by an electric current which could be increased to 240 amps, and the spectra of the strongly-heated substances were observed by a direct-vision spectroscope lying in the line of the axis of the carbon tube and directed towards a flask connected to the tube. At temperatures above $1,000^{\circ}$ the emission spectrum of iodine was seen, and it appeared to correspond to the ordinary absorption spectrum of iodine vapour. For the nitrogen experiments magnesium powder was introduced into the carbon tube together with the nitrogen; in this way every trace of oxygen was removed, while the simple magnesium spectrum caused but little complication. The temperature reached was not measured accurately, but was probably not far from $3,000^{\circ}$ C. when the lines appeared. The lines well observed were the following:—

	λ	
Brilliant red	668.5	?
Brilliant	643.0	Fe = 643.1
Brilliant	640.5	Fe = 640
Brilliant	632.5	N = 632.1
Brilliant	630.5	N = 631.4
Brilliant	629.0	N = 629.5
Weak	619	Fe = { 619.1 618.8
Brilliant	591	?
Double black line	589.5	Na
Double black line	589.5	Co = 589.8
Distinct	518	Mg = 518.8
Distinct	517	Mg = 517.2
Distinct	514.5	C = 514.4 Fe = 514.1

In the last column are given the symbols of the elements to which the observed lines are ascribed. It will be seen that difficulty was found in determining the signification of the brilliant red line ($\lambda = 668.5$) and the bright yellow line ($\lambda = 591$). D. H. J.

2886. Atomic Structure in the Light of Secondary Spectra. P. G. Nutting. (*Nature*, 70. p. 842, Aug. 11, 1904.)—The author finds that the amount of capacity necessary to produce secondary or line spectra increases very rapidly with decreasing wave-length. The primary or band spectrum does not go over suddenly as the critical capacity is reached, but the red and yellow portions go over first, then finally, at a much greater capacity, the violet. Critical capacity can be expressed as a function of the wave-length by the exponential $e^{\frac{h}{\lambda\lambda_0}}$, approaching a constant value in the infra-red and the value infinity in the ultra-violet, perhaps not further than $\lambda = 250\mu$. It is well known that primary spectra do not exhibit the Zeeman effect; Runge has suggested that the primary spectrum is given by positive ions, while the secondary spectra are due to the electrons rotating round the positive nucleus [Kayser's Spectroscopy, II., p. 660]. The author thinks this explanation unsatisfactory from the point of view of his experiments; he suggests that an atom composed of rotating rings of electrons [see Abstracts Nos. 961, 962,

and 2606 (1904)] much more readily explains the facts. If there were, for example, as many rings as there are bands in the primary spectrum, then these rings with moderate excitation would vibrate radially and tangentially, as well as perpendicularly to their planes, and these vibrations would give rise to the lines composing each band. Such lines would not show the Zeeman effect. Excessive excitation would break up the rings and allow the electrons to move independently. The larger rings would be the first to break up; the smallest rings perhaps would not be broken up at all, hence the critical capacity would vary with the wave-length and become infinite for moderately short waves. E. C. C. B.

2887. *Induced Thorium Activity.* F. v. Lerch. (Ann. d. Physik, 12. 4. pp. 745-766, Oct., 1903. Phys. chem. Institut, Göttingen, July, 1903.)—The researches described give the following results: The metals directly affected by thorium emanation show a falling off depending on the same exponential law. Palladium appears to absorb the radiation. The activity continues to cling to the ions after solution of the metal. The induced activity can be detached from the induced plate and obtained by electrolysis at the kathode. Out of these solutions, containing no trace of thorium, active metallic precipitates could be obtained. When dipped in an active solution the following metals became active: Cu, Sn, Pb, Ni, Fe, Cd, Zn, Mg, Al; but Pt, Pd, Ag remained inactive. With reference to the series of potential differences, the principal ingredient, which forms the natural decay of activity, lies between Cu and Pb in the neighbourhood of Hydrogen. The material nature of the induced activity seems probable. J. J. S.

2888. *Emanations from Incandescent Metals.* T. Tommasina. (Comptes Rendus, 138. pp. 1157-1159, May 9, 1904.)—These emanations induce radio-activity in all surrounding bodies. They are of three kinds: (a) No penetrative power, diffuse in air, with a tendency to follow the lines of electric force, and carry positive charges; (b) traverse very thin paper or aluminium, carry negative charges; (c) strongly ionise air, produce the same discharge of the electroscope whatever be the sign of its charge, appreciably travel through thick card, produce feeble fluorescence on platino-cyanide of barium. The rays γ are copiously emitted by an incandescent platinum wire and by disruptive discharges between wires of any metal. A. D.

2889. *Penetrating Rays of Radium.* F. Paschen. (Ann. d. Physik, 14. 1. pp. 164-171, May, 1904.)—The γ -rays emitted by radium salts are generally regarded as analogous to the Röntgen rays. But on comparing the relative amounts of ionisation produced in different gases by the two kinds of radiation no proportionality is observed, and the coefficients for the γ -rays are much more nearly parallel with those for the α - and β -rays than with those for the Röntgen rays. A similar contrast is found in the two series of absorption-coefficients for different gases. Although the ordinary tests do not indicate any deviation of the γ -rays in either an electrostatic or electromagnetic field the author considers that the γ -rays carry a negative charge. A quantity of radium bromide, enclosed in a glass tube with walls 0.8 mm. thick, was insulated in a vacuum by a quartz suspension and found to gain in potential at the rate of 182.5 volts per min. owing to the escape of the negatively-charged β -rays. The radium salt was then enclosed in a sheath of lead 1 cm. thick, and the change of potential was again determined. The absorption coefficient of the β -rays by lead is 62.5 and the absorption by

1 cm. should reduce the amount of radiation to $e^{-0.25}$ or 10^{-27} of that originally transmitted. The actual increase of potential was, however, only reduced in the ratio 1:85, and this residual effect the author attributes to the γ -rays, which he therefore regards as negatively charged. The following table shows the way in which the coefficient of absorption varies with the thickness of lead through which the radiation has travelled. The first line shows the thickness of the lead sheath in each experiment, the second line shows the electrostatic capacity of the apparatus, the third line the rise of potential per min., the fourth line the current in amps. (rate of escape of negative electricity), and the last line the coefficient of absorption of the rays transmitted through the thickness of lead used in the successive experiments:—

Thickness of lead, d ...	0	0.0264	0.0528	0.48	1.32	1.92 cm.
Capacity.....	1.93	3.172	3.57	3.31	4.655	5.87×10^{-12} Farad
Rise of potential $\frac{dV}{dt}$...	132.5	16.48	8.02	2.86	0.672	0.249 volt/minute
Current	426.3	87.16	47.7	15.8	5.21	2.435×10^{-14} amp.
Absorption coefficient α	60.13	22.82	2.593	1.32	1.27	—

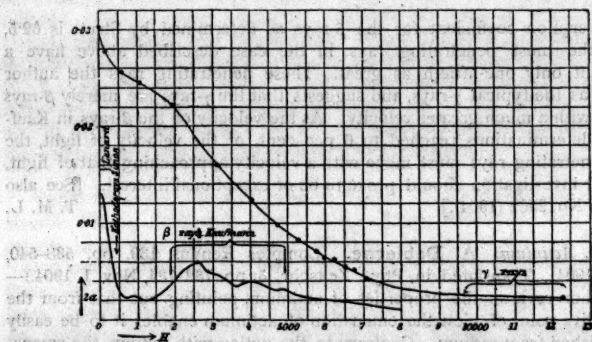
The absorption coefficient for the β -rays as determined by Strutt is 62.5, whilst the most penetrating rays in the case described above have a coefficient only one-fiftieth as great. These penetrating rays the author regards as the typical γ -rays, and suggests that the γ -rays are merely β -rays moving with a much greater velocity. As the velocity of the β -rays in Kaufmann's determinations reached to 6 per cent. of the velocity of light, the more penetrating rays must move with a velocity approaching that of light, and their investigation should prove to be of exceptional interest. [See also Abstract No. 2562 (1904.)] T. M. L.

2890. Actinium. A. Debierne. (Comptes Rendus, 139. pp. 538-540, Oct. 3, 1904. Translated in Phys. Zeitschr. 5. pp. 782-784, Nov. 1, 1904.)—The author reviews the properties of actinium, pointing out that from the radio-active point of view the emanation of actinium enables it to be easily distinguished from radium. Contrary to the action with radium, the emanation of actinium is easily separated from the solid, and the ionisation it produces is much greater than that produced by solid actinium. It also provokes phosphorescence and scintillation. The law of decay for the emanation is characterised by the decrease to $\frac{1}{2}$ occurring in 4 sec.; that of the induced radio-activity by decrease to $\frac{1}{2}$ in 40 min. These points characterise it as in a spectrum a line characterises an element. The researches of Giesel on the body called by him *emanium* are then referred to. Recent comparisons by the author with Giesel and P. and Mme. Curie have shown that the substance behaves exactly the same as actinium. It is therefore considered probable that the active lanthanum of Giesel contains the same radio-active substance as the author's own active thorium from which the actinium was obtained. The author points out that the name actinium should be employed for this substance, and that all researches relating to the Emanationskörper or emanium should be considered as dealing with actinium. Reference is made to the fractional crystallisation of the rare earths, carried out by Urbain. After 1,500 crystallisations the different substances separated out in the order lanthanum, praseodymium, neodymium, samarium, and the least soluble lanthanum portions were almost inactive; the most soluble portions, neodymium, samarium were extremely active, the

activity being apparently concentrated on to these two. The chemical properties of actinium can only be known with certainty when the pure substance is obtained. Results in this direction obtained by the author and Urbain are to be published shortly. [See also Abstract No. 419 (1904).]

L. H. W.

2891. *Kathode Rays of Radium.* F. Paschen. (Ann. d. Physik, 14. 2. pp. 889-405, June, 1904.)—A quantity of radium bromide, connected to earth, was surrounded by a well-insulated and vacuum lead cylinder, and the whole was exposed to a variable magnetic field between the poles of a powerful electromagnet. The effect of the magnetic field was to deflect the radiations from the radium salt in such a way that when the magnetic field was sufficiently strong the rays were prevented from reaching the lead cylinder. When no magnetic field was used the whole of the negative charge carried by the radiation was absorbed by the lead cylinder, but as the magnetic field was increased in intensity, an increasing proportion of the radiation was prevented from reaching the cylinder, and the charge acquired by the latter was



correspondingly reduced. The reduction in the charge $2a$ transmitted to the lead cylinder is clearly shown by the upper curve in Fig. 1. The lower curve shows the differentials of this curve, and represents the proportion of the radiation that was stopped by successive equal increments of the magnetic field. From these curves it appears that the cathode rays of radium contain rays of all velocities, including some slower than the cathode rays investigated by Simon, and others with velocities much greater than those of the cathode rays investigated by Kaufmann. The slowest rays, whose mass appears to be considerable, are very similar to those which Lenard has produced by the action of ultra-violet light, and possess a very high power of ionisation; this is in accordance with their strong absorption by gases even under considerably reduced pressure; under atmospheric pressure these rays are probably responsible for the ionisation of the air in the immediate neighbourhood of a glass vessel containing radium, but their velocity is then probably very much less than before entering the glass. The fastest rays are the penetrating rays described in Abstract No. 2889 (1904), which are very difficult either to absorb or deflect, and which the author regards as constituting the γ -rays of radium; their velocity appears to approach that of light, and their properties are still under investigation.

T. M. L.

2892. Decay of Radio-activity and Life of Radium in the Finely-divided State. **A. Voller.** (Deutsch. Phys. Gesell., Verh. 8. 19. pp. 291-292, Oct. 15, 1904.)—The author has carried out a series of long-continued experiments on the time rate of decay of the radio-activity of radium, and on the life of radium in very small quantities, with the object of testing the view of J. J. Thomson that the radiation intensity depends upon its state of subdivision. Pure radium bromide in small quantities (10^{-3} to 10^{-6} m.gm.) in different thicknesses on glass plates was examined for the ionising effect on an Elster-Geitel-Ebert electroscope without aspirator. The rates of discharge with and without the radium were examined, care being taken that the emanation produced no effect. As a result it was found that the weakest plates became quite ineffective after 15 days; others after 21, 61, and more days; the stronger ones had diminished in effectiveness after 100 days, but were still radio-active. The life, as a function of the concentration, gives a rapidly rising curve, from which one can see that from 10^{-3} m.gm. the radio-activity would only cease after years; the life attributed to radium by P. and Mme. Curie, and by Ramsay, Soddy, and others is considered consistent with these results. **L. H. W.**

REFERENCES.

2893. Parallax Stereograms. **F. E. Ives.** (Photographic Journ. 43. pp. 218-220; Remarks by **J. W. Swan**, p. 220, Aug., 1903. Paper read before the Jubilee Commemoration Congress.)—A description of the method of making the parallax stereogram photograph, which consists of a single transparent image divided into lines (100 to 150 to the inch); alternate lines form one of a stereoscopic pair of images and the intermediate lines the other. **J. W. P.**

2894. Disadvantages of Cemented Objectives. **G. Eberhard.** (Zeitschr. Instrumentenk. 23. pp. 274-277, Sept., 1903. Astrophys. Observatorium, Potsdam, July 17, 1903.)—The author gives a series of tests by Hartmann's zone method of the influence produced on the performance of an objective having the lens components cemented together instead of being merely in contact with a possible thin layer of enclosed air. The influence is rather marked when the varying temperature corrections are plotted. **C. P. B.**

2895. Filters for the Production of Monochromatic Light. **J. Hartmann.** (Zeitschr. Wiss. Photog. 1. pp. 259-261, 1903.)—The light from a mercury arc lamp consists of rays of certain wave-lengths, of which the most important are at $\lambda\lambda = 5,790, 5,461, 4,916, 4,359, 4,047$, and 3,650. By using the following filters homogeneous light from the mercury arc lamp can be obtained at the above wave-lengths:—

λ .	Filter.	λ .	Filter.
5,790.	Chrysoidine and eosine.	4,359	Cobalt glass and quinine solution.
5,461	Neptune green S and chrysoidine.	4,047	Methyl violet and quinine sulphate.
4,916	Gaucha green B extra (Berl. Anil. A.-G.) and quinine.	3,650	Methyl violet and nitrosodimethylaniline in separate absorption cells.

E. C. C. B.

2896. Optical Resonance. **C. Scotti.** (N. Cimento, 7. pp. 384-385, May, 1904.)—A bibliography of the subject is given and a general mathematical discussion. Kossonogoff's work is dealt with in some detail, and his results confirmed in so far as they attribute the colours of the scales of lepidoptera to optical resonance. **D. H. J.**

2597. *Photographic Optics*. **J. Thover**. (Comptes Rendus, 139. pp. 500-501, Sept. 19, 1904.)—A short note on the depth of the field and of the focus. J. W. P.

2598. *Optically Active Esters of β -Ketonic and β -Aldehydic Acids*. IV. *Condensation of Aldehydes with Menthyl Acetoacetate*. **A. C. O. Hann and A. Lapworth**. (Chem. Soc., Journ. 85. and 86. pp. 46-56, Jan., 1904.)—The following are the substances prepared, together with their physical constants: Dimethyl ethylidene bisacetoacetate: m.p. 194-196°; crystals have weak double refraction; extinction straight; $[\alpha]_D = -24.9^\circ$ changing to -26.5° on the third day. Menthyl propylidene acetoacetate: m.p. 84-88°; crystals have strong double refraction; $[\alpha]_D = -84.9^\circ$. Dimethyl propylidene bisacetoacetate: m.p. 201-207°; $[\alpha]_D = -26.9^\circ$. Dimethyl *n*-butylidene bisacetoacetate: m.p. 184°; $[\alpha]_D = -16.8^\circ$. Dimethyl isobutylidene bisacetoacetate: m.p. 202°; $[\alpha]_D = -42.6^\circ$; slight mutarotation observed. Menthyl benzylidene acetoacetate: m.p. 133-134°; $[\alpha]_D = -10.0^\circ$. Dimethyl benzylidene bisacetoacetate: m.p. 206°; $[\alpha]_D = -80.4^\circ$. [See also Abstract No. 1011 (1903).] A. F.

2599. *Relation between the Constitution and Absorption Spectra of Rosaniline Dyes*. **J. Formánek**. (Zeit. Farb. Text. Chem. 2. pp. 473-482, 1903. Beibl. Ann. d. Physik, 28. 1. pp. 27-28, 1904.)—Deals with the changes produced in the absorption spectra of these dyes by the introduction of different substituents into the molecules. T. H. P.

2900. *Motion of Particles in an Ideal Atom Illustrating the Line and Band Spectra and the Phenomena of Radio-activity*. **H. Nagaoka**. (Mathematical and Physical Soc., Tokyo, 2. 11. pp. 140-141, April, 1904.)—This is the full paper, an outline of which has already appeared [see Abstract No. 2598 (1904)]. E. C. C. B.

2901. *Radio-activity of Metals*. **A. Voller**. (Phys. Zeitschr. 4. pp. 666-667, Oct. 1, 1903. Phys. Staatslaboratorium, Hamburg, Sept. 10, 1903.)—A criticism of McLennan and Burton's experiments [see Abstract No. 1936 (1904)], in which it is pointed out that the apparent spontaneous radio-activity of the metals dealt with may be due to the development of Volta contact forces, as in the system—inner metal cylinder, brass rod, quadrants of electrometer—which was made use of in the measurements, there occurs the contact e.m.f. metal of cylinder | metal of quadrants. J. J. S.

2902. *Radium Radiation*. **W. Wien**. (Phys. Zeitschr. 4. pp. 624-626, Sept. 1, 1903. Physik. Institut, Würzburg, July, 1903.)—Observations were made based upon the self-electricification of radium. The two kinds of radiation appeared to be sent out in not too different amounts considering the quantity of electricity. Taking Des Coudres' observations on the ratio m/c , viz., 1.6×10^{-4} for the positive particles and 1×10^{-7} for the negative, $m = 2.9 \times 10^{-20}$ gm. per sec. for the negative and 4.6×10^{-17} for the positive. Hence the energy of the radiation is not inconsiderable. Taking $v = 2.5 \times 10^{10}$ for the negative and 1.65×10^9 for the positive, for the first $\frac{1}{2}mv^2 = 8.7$ ergs and for the others $\frac{1}{2}mv^2 = 60$ ergs per sec. J. J. S.

2903. *Influence of Electrons on Colloidal Solutions*. **W. B. Hardy**. (Cambridge Phil. Soc., Proc. 12. p. 201, Oct., 1903.)—Globulin from blood was dissolved in a trace (a) of acetic acid, (b) of sodium hydrate. In the first case the globulin moved in an electric field from anode to kathode, in the second from kathode to anode. In the first case, too, the solution became more mobile and less opalescent when exposed to the radiations from radium bromide; in the second case the globulin, when similarly exposed, was changed into a jelly in three minutes. D. H. J.

2904. Origin of Radium. J. Joly. (*Nature*, 70, p. 246, July 14, 1904.)—The author describes a series of tests that he is commencing to make on the amount of emanation liberated from artificial chalcocite, which is inactive, whilst the natural mineral is active. Experiments are also in progress with reference to the effect of heavy metals on the possible prospective liberation of radium emanation from uranium nitrate initially freed from radium.

T. M. L.

2905. Radio-activity of Cement from the Neighbourhood of Rome. G. Martignelli and A. Sella. (*Accad. Lincei, Atti*, 13, pp. 156-158, Aug. 7, 1904.)—The specimens taken from various caves in the neighbourhood of Rome were examined and found to possess slight radio-activity.

S. G. S.

2906. A New Radiation or Emanation. J. J. Taudin Chabot. (*Phys. Zeitschr.* 5, p. 517, Aug. 15, 1904.)—The author has endeavoured to trace the cause of the photographic effect referred to in Abstract No. 1428 (1904), and describes a number of experiments which lead to no result. He concludes that the selenium used must have a feeble radio-activity, somewhat increased when a current passes through it—but this explanation seems open to doubt from the results of the experiments, as an exposure of 1,008 hours was necessary to obtain the least photographic trace, and no mention is made of testing the action of the black paper employed.

L. H. W.

2907. Physiological Effects of the Radium Emanation. E. Dorn and F. Wallstabe. (*Phys. Zeitschr.* 5, pp. 568-570, Sept. 15, 1904; *Physikal. Inst. Halle*, Aug. 7, 1904.)—The authors have investigated the effect of ordinary tap-water charged with the radium emanation, and also of air similarly charged, upon rabbits and white mice respectively. The number of animals used (3 and 1 control) precludes the deduction of very definite results. In the first case the control rabbits died during the period, while all the test animals survived. The general conclusion is drawn that the emanation is poisonous only when present in larger amounts. The results obtained by Bouchard, Curie, and Balthazard [see Abstract No. 1940 (1904)] are considered as being probably due to the greater quantity of emanation used.

L. H. W.

2908. Effect of Radium Rays on Living Organic Substances. L. Matout. (*Revue Int. d'Electrothérapie*, 13, pp. 373-375, April-May-June, 1904.)—The seeds of mustard and cress enclosed in tissue paper were submitted to the action of radium. After a week's exposure the seeds failed to germinate when placed under favourable conditions, while 80 per cent. of other seeds treated in exactly the same way, except that they were not exposed to radium, developed normally. The author comments on Rhen's experiments in which vegetable seeds were sown on garden mould, below which tubes of radium were placed, the radium being separated from the seeds by a thin layer of mould. The fact that no effect was produced proves that it is the β -rays which act on living organic matter, and not the γ -rays, for the latter rays could traverse the layer of mould, and the former only would be intercepted.

H. W. P. Y.

2909. The N-rays in Diseases of the Nervous System. G. Ballet. (*Archives d'Él. Médicale*, 12, pp. 635-636, Aug. 25, 1904. *Press. Med.* 22, March 16, 1904.)—In paralysis, with or without appreciable atrophy due to lesions of the nerves, there is a diminution of the emission of n -rays. Lesions of the lower motor neuron also cause a diminution, but when it is the upper neuron that is affected the emission of n -rays is increased. Hysterical paralysis of a muscle is accompanied by an increase and not a diminution. After death the muscles no longer exert an action on the phosphorescent screen, but the nerves continue for a time to increase the phosphorescence, grey matter being more active than white.

H. W. P. Y.

HEAT.

2910. *Indirect Method of Measuring the Temperature of Liquid Air.* U. Behn and F. Kiebitz. (Ann. d. Physik, 12. 2. pp. 421-429, Aug., 1908. Laboratorium des Physikal. Vereins, Frankfurt, June, 1908.)—The density of a mixture of liquid nitrogen and oxygen varies between 0.791-1.135, whilst the temperature varies between $-195^{\circ}.7$ and $-182^{\circ}.4$, so that a measurement of the density affords a measurement of the temperature. It is found that the use of specific gravity balls affords a convenient means of measuring the density. These were blown by Heraeus from quartz. This material was selected on account of its small coefficient of expansion. The "durax glass" of Schott was also found to be suitable, and was used for making the larger bulbs. Determinations with liquid air were made in an unsilvered glass vessel with a double wall, the interspace being vacuous. This vacuum vessel was placed within a beaker having P_2O_5 at the bottom, which prevents a deposit of moisture on its outside. The temperature of the liquid air could be raised by a spiral of constantan through which an electric current could be passed. Samples of the liquid or the gas above it were submitted to analysis, and the method of Baly [see Abstract No. 1884 (1900)] used to estimate the temperature of the liquid, and simultaneously it was noted which of the balls represented the density of the liquid. Curves are given showing the relation between density and temperature for liquid air. It is shown that the alteration of the volume of the ball with change of temperature does not produce any perceptible error. The "swimmers" can be obtained from Burger, in Berlin. W. W. H. G.

2911. *Latent Heat of Sublimation of Carbon Dioxide and of Evaporation of Air. A Correction.* U. Behn. (Ann. d. Physik, 12. 3. pp. 669-670, Sept., 1908. Laboratorium des Physikal. Vereins, Frankfurt, July 7, 1908.)—In his paper under the above title [see Abstract No. 844 (1900)] the author gave the calculated value of the specific volume of liquid air to be $\frac{1}{0.00287}$ when it should be $\frac{1}{0.00424}$. From the latent heat of evaporation at ordinary pressures the specific volume can be found from $S = Jr/T \cdot dP/dT$, which gives the value $\frac{1}{0.00280}$. The great discrepancy cannot be explained by experimental error, but more probably arises from an error in the value of $\frac{dP}{dT}$ used. Assuming more recent values for this coefficient [see Abstracts Nos. 1884 (1900) and 1029 (1908)] the value of S comes out $\frac{1}{0.0045}$, while that from Gay Lussac's law is $\frac{1}{0.00481}$. E. C. C. B.

2912. *Testing and Annealing of Thermometers.* A. Böttcher. (Zeitschr. Instrumentenk., Beib. 17. pp. 154-160, Sept. 1, 1908. From a paper read before the 14 meeting of the Deutscher Mechanikertage, Ilmenau, Aug. 14, 1908.)—Deals with the difficulties met with in constructing satisfactory mercury thermometers for high temperatures; these are connected with the

introduction of compressed gases, and with adjustment and calibration at high temperatures. Boiling sulphur gives a good constant-temperature bath, but above 400°C . a bath of uniform temperature is difficult to obtain. Ovens heated electrically are recommended. The difficulties arising from the rise of zero and thermal "afterworking" are described, as well as the efforts to overcome them by artificial "ageing" or annealing of thermometers. New researches on these questions are described as arising out of unsatisfactory results which had persisted even after the careful annealing of the thermometers as carried out by Schott, of Jena. As a result, it is stated that the rise of zero which occurs after annealing may be as much as 40°C ., but that heating for a short time to a temperature 100°C . above the initial softening temperature of the glass, followed by cooling without special retardation, produces satisfactory results. Standard methods of treating and marking annealed thermometers are suggested. W. Ros.

2913. Temperature of Ignition and Slow Combustion of Sulphur in Oxygen and in Air. H. Moissan. (Comptes Rendus, 187. pp. 547-553; Oct. 12, 1903.)—The method previously used by the author in the case of carbon [see Abstract No. 940 (1903)] gives for the ignition-point of octahedral sulphur in oxygen temperatures varying from 275° to 280° . By keeping the sulphur in an atmosphere of carbon dioxide, and heating the oxygen by passing it through the molten sulphur, it is found that at temperatures below 282° sulphur dioxide is formed without any incandescence, while, when this temperature is reached, the reaction increases in vigour and a slight explosion occurs, followed by immediate incandescence. In air the ignition-point of sulphur is 363° , this being raised to 445° when 5 per cent. of sulphur dioxide is present, and to above 465° with 10 per cent. of the dioxide. The temperature at which sulphur vapour ignites in air is about 285° . The slow combustion of sulphur in, or its combination with, oxygen in sealed tubes is quite appreciable at 100° after 12 hours, and even at 20° after the lapse of a month. The action is much slower in air, but traces of sulphur dioxide can be detected after three months at 16° - 26° . T. H. P.

2914. Thermal Conductivity of Badly Conducting Substances determined by Neumann's Method. H. Hecht. (Beibl. Ann. d. Physik, 28. 2. pp. 99-101, 1904. Extract from Königsberger Dissertation, 1903. Ann. d. Physik, 14. 5. pp. 1008-1080, Aug. 28, 1904.)—Both spheres and cubes of the substances were experimented upon, the temperatures at various points in the interior being determined by iron-constantan thermoelectric couples. Determinations on rate of cooling and rate of warming were both made at ordinary pressures and at low vacuum. The following table gives some of the results obtained:—

Material.	Density.	Sp. Ht.	Temp. Conductivity.	Internal Heat Conductivity.
Marble I.	2.71	0.202	0.01026 (cm. ² /sec.)	0.00562 (gm./cm. ² .sec.)
Marble II. ...	2.72	0.206	0.00850	0.00476
Glass	2.515	0.185	0.00548	0.00255
Sandstone ...	2.21	0.240	0.00460	0.00244
Gypsum	2.13	0.275	0.00802	0.00177

S. G. S.

2915. *Reaction between Nitric Oxide and Oxygen at Low Temperatures.* L. Francesconi and N. Sciacca. (*Gazzetta Chim. Ital.* 34. 1. pp. 447-457, 1904.)—The authors have made a number of experiments on the influence of temperature on the reaction between nitric oxide and oxygen, on the conditions under which the nitrous anhydride and nitrogen peroxide formed pass into one another under the action of nitric oxide or oxygen, and on the stability of nitrogen trioxide. The results arrived at are briefly as follows: (1) Liquid nitric oxide and oxygen or gaseous oxygen and liquid or solid nitric oxide, or gaseous nitric oxide and liquid oxygen, mixed in all proportions, even with the oxygen in large excess, always yield nitrogen trioxide. (2) Gaseous nitric oxide and oxygen, the latter being in excess, also give nitrogen trioxide if they react at a temperature lower than -110° . (3) When subjected to the action of oxygen, nitrogen trioxide is transformed into nitrogen peroxide only at temperatures above -100° . (4) The reduction of nitrogen peroxide to nitrogen trioxide by nitric oxide commences at -150° . (5) Nitrogen trioxide is stable under the ordinary pressure up to a temperature of -21° . T. H. P.

2916. *Thermic Properties of Solids and Liquids.* S. Lussana. (*N. Cimento*, 7. pp. 855-874, May, 1904.)—Employing a dilatometer containing petroleum, determinations of the compressibility of lead, zinc, tin, cadmium, and copper, and of the expansion of the three last under varying pressures, lead to the conclusions that: (1) the coefficient of compressibility of solid bodies diminishes with increase of pressure and increases with the temperature; (2) the coefficient of expansion for any given pressure increases with the temperature, the increase becoming greater as the temperature is raised; (3) the coefficient of expansion diminishes with increase of pressure, probably reaching a minimum, after which it may increase. With copper this is found to be the case between the limits of pressure studied (1 to 3,000 atmospheres), a minimum being reached at a pressure of 500 atmospheres, after which the coefficient rises with increase of pressure. From the results obtained for the coefficients of compressibility and the elasticities of the above metals, the values of Poisson's ratio are calculated, showing the ratio to increase with the temperature. W. H. St.

2917. *Influence of Moist Alcohol and Ethyl Chloride on the Boiling-point of Chloroform.* J. Wade and H. Finnmore. (*Chem. Soc., Journ.* 85. and 86. pp. 938-949, July, 1904.)—Differences in the anæsthetic properties of chloroform prepared from alcohol and from acetone, have led the authors to investigate whether any chemical difference could be detected. Systematic fractionation through a Young's evaporator still-head shows that both kinds give an appreciable fraction below 60° , but while the "acetone" chloroform invariably commences to boil at 55° , that made from alcohol begins to boil at 54° . Mixtures of rectified chloroform (distilling between 61.1 and 61.2°), with alcohol or water or both, were then fractionated to prove whether the distillates below 60° were due to a physical cause, but no fraction was obtained below 55° . The nature of the fraction $54-55^{\circ}$ from "alcohol" chloroform was finally examined and found to contain ethyl chloride, which was identified by conversion into silver propionate. A mixture of chloroform with 0.5 per cent. alcohol and 0.1 per cent. ethyl chloride begins to boil at 52.65° , so that the presence of 0.05 per cent. ethyl chloride would account for the lower boiling fraction of chloroform made from alcohol. "Acetone" chloroform, to which has been added a small quantity of ethyl chloride, is

found to give results therapeutically identical with those from "alcohol" chloroform, and the authors consider that the addition of a further small quantity of ethyl chloride would be beneficial, but above 1 per cent. the mixture is not permanent.

W. H. St.

2918. *Devitrification*. W. Guertler. (Zeitschr. Anorg. Chem. 40. 2. pp. 268-279, July 8, 1904. Inst. für anorg. Chemie der Univ. Göttingen.)—Various substances, such as Na_2SiO_3 , $\text{Co}_2\text{B}_2\text{O}_5$, CuB_2O_4 , MnB_4O_7 can, by rapid cooling from the melted state, be obtained in the form of "glasses," i.e., supercooled highly viscous liquids. These are then gradually heated in an electric resistance furnace, and time-temperature curves plotted. A sudden upward bend of the curve, almost parallel to the temperature-axis (ordinates), indicates the point of devitrification, i.e., the point when rapid conversion of the unstable non-crystalline form (glass) into the crystalline form occurs with evolution of heat. This change is a non-reversible "explosive" action. The temperature of the glass was ascertained by a le Chatelier thermo-element. The following list gives the devitrification-temperatures of the four substances mentioned above :—

Na_2SiO_3	$550^\circ \pm 20$	CuB_2O_4	$675^\circ \pm 15$
$\text{Co}_2\text{B}_2\text{O}_5$	$640^\circ \pm 20$	MnB_4O_7	$670^\circ \pm 20$

F. G. D.

2919. *Absorption and Thermal Evolution of Gases Occluded by Wood Charcoal at Low Temperatures*. J. Dewar. (Comptes Rendus, 189. pp. 261-264, July 25, 1904. Roy. Soc., Proc. 74. pp. 122-127, Aug. 10, 1904. Annal. Chim. Phys. 3. pp. 5-12, Sept., 1904. Amer. Journ. Sci. 18. pp. 295-300, Oct., 1904.)—In the year 1875 Dewar and Tait utilised the absorbing power of wood charcoal for gases to produce a vacuum so good that an electric spark would not cross it. The fact has also been noticed that when a Crookes' radiometer is filled with air at the atmospheric pressure and connected with a chamber containing charcoal, that when the latter is cooled for 80 sec. to the temperature of liquid hydrogen, the radiometer is sensitive to the radiation of a candle. New properties of wood charcoal at low temperatures are now published. The thermal effects produced by the absorption of different gases have been studied by the use of a special type of calorimeter. This is described. It consists essentially of a small glass bulb containing the charcoal surrounded by liquid air. When the charcoal absorbs the gas under study, the amount of liquid air evaporated will be a measure of the calories produced. The table below shows the results per c.cm. of charcoal :—

	Volume absorbed at 0°C . c.cm.	Volume absorbed at -185°C . c.cm.	Heat produced in gm.-calories.
Hydrogen	4	185	9.3
Nitrogen	15	155	25.3
Oxygen	18	230	34
Argon	12	175	25
Helium	2	15	2
Electrolytic gas ...	12	150	17
$\text{CO} + \text{O}$	80	195	34.5
CO	21	190	27.5

Helium furnishes, it is seen, at low temperatures a marked exception to the other gases. The next part of the research relates to the effect of charcoal

on mixtures. When 50 gm. of carbon at -185° is saturated in a current of dry air, 5 to 6 litres are absorbed in 10 min. After this sudden effect has ceased, and the air is passed slowly over the carbon, the air leaving the charcoal shows 98 per cent. nitrogen. After 30 min. the carbon was withdrawn from the liquid air and attained the laboratory temperature of 15° , when it gave up 5.7 litres of gas containing 56 per cent. of oxygen. The experiment was repeated by the placing the vessel containing the carbon saturated with air at -185° in a receiver with a double envelope containing a small quantity of liquid air. Under these conditions the temperature slowly rises, and the gas liberated can be fractionated. The result was the—

1st litre contained 18.5 per cent. of oxygen	4th litre contained 72.0 per cent of oxygen
2nd " " " 30.6 " " "	5th " " " 79.0 " " "
3rd " " " 53.0 " " "	6th " " " 84.0 " " "

A new method is thus furnished for separating oxygen from air.

W. W. H. G.

2920. *Heats of Combustion of Organic Compounds containing Sulphur and the Halogens.* P. Lemoult. (Comptes Rendus, 189. pp. 181-184, July 11, 1904.)—A continuation of the author's new method for calculating heats of combustion [see Abstracts Nos. 827 and 2941 (1904)]. For compounds containing sulphur and nitrogen of the form $C_xH_y - a(N_mH_n)O_pS_n$, he proposes the

$$\text{formula: Heat of combustion} = 102x + \frac{55}{2}y + (16.5m - 10a) - \Sigma p\phi + 151n,$$

the value of ϕ varying with the state of combination of the oxygen. This formula is equally applicable if "ethylene" or "acetylene" linkages are present, but for the $(C_2=S)$ group it is necessary to subtract 12 cal. from the result obtained. For halogen compounds the values $(C-Cl)=10$ cal., $(C-Br)=25$ cal., and $(C-I)=85$ cal. are given.

W. H. Si.

2921. *Separation of the most Volatile Gases from Air without Liquefaction.* J. Dewar. (Roy. Soc., Proc. 74. pp. 127-181, Aug. 10, 1904. Annal. Chim. Phys. 8. pp. 12-20, Sept., 1904.)—Making use of the small absorption of hydrogen, helium, and neon by charcoal [see Abstract No. 2919 (1904)], these gases may be separated from air by sucking the latter through tubes filled with charcoal, placed in vacuum flasks containing liquid air, into a sparking-tube at the end of which is blown a bulb also filled with charcoal. After extracting 200 c.cm. of air, on sparking, the hydrogen lines C and F, the neon yellow and some of the orange lines, together with the helium yellow and green, are quite distinct. From 8 litres of air discharge-tubes are obtained giving the neon and helium spectra associated with a ruddy glow discharge. The spectroscopic test for helium is apparently as delicate as for neon, λ_{4481} being recognisable. The method is equally applicable to the treatment of gaseous products from minerals or springs.

W. H. Si.

2922. *Retardation of Combustion by Oxygen.* H. E. Armstrong. (Roy. Soc., Proc. 74. pp. 86-89, Aug. 10, 1904.)—Recent work on slow combustion [see Abstracts Nos. 2278 (1902), 422 and 2387 (1904)] leads to the conclusion that the first step in the combustion of hydrocarbons is one of hydroxylation, the hydroxy-compound then undergoing further transformation into water and an aldehyde, which latter then splits up into a hydrocarbon (or hydrogen, in the case of formaldehyde) and carbon monoxide. Thus, with dihydroxy-

ethane: $C_2H_5(OH) \rightarrow CH_3.CHO + H_2O \rightarrow CH_4 + CO + H_2O$. In the introduction of oxygen into the hydrocarbon molecule, water plays an important part; it may be assumed that the water is the immediate source of the oxygen of combustion, and that the free oxygen only acts as a depolariser. This explains the fact that the velocity of the explosion-wave has its maximum value in presence of a considerable quantity of water vapour. The gradual retardation of the explosion velocity when the proportion of steam is increased beyond a certain limit may be due to its diluting action, to an increase in the extent to which the water is unburnt by the carbon monoxide, and, probably in no slight measure, to the tendency of the steam to hold back the oxygen owing to the formation of hydrogen peroxide, which must have its maximum stability at a high temperature. The oxygen and steam hence hold one another mutually in check, a fact which explains the retardation of combustion by oxygen. T. H. P.

2023. *Decomposition of Ammonia by Heat.* E. P. Perman and G. A. S. Atkinson. (Roy. Soc., Proc. 74. pp. 110-117, Aug. 10, 1904.)—The rate of decomposition of ammonia between temperatures varying from 677° to $1,111^\circ$ is determined by heating the ammonia in a porcelain globe in a furnace, at constant volume, the change in pressure, observed by means of a manometer attached, measuring the amount of decomposition. The results show that the decomposition is essentially monomolecular, and may be represented by the equation $NH_3 = N + 3H$, a slight deviation from this at the lower temperatures being probably due to the volume and mutual attraction of the molecules. The presence of catalytic agents such as mercury, iron wire, or platinum black considerably increases the rate of decomposition, which is also influenced by the state of the globe. The authors do not confirm the view of Ostwald that, when 98 per cent. of the ammonia is decomposed, equilibrium ensues, being unable to detect the formation of any appreciable quantity of ammonia on passing dry nitrogen and hydrogen through a red-hot iron tube, or a heated glass tube containing iron filings or porcelain. W. H. Sr.

2024. *Liquefaction of Helium.* J. Dewar. (Comptes Rendus, 189. pp. 421-422, Aug. 16, 1904.)—By utilising wood charcoal at a low temperature as a gas absorber, and cooling a tube of helium by means of liquid hydrogen, it has been shown that the boiling-point of helium must be about 6° absolute temperature. The existence of very small quantities of helium has been proved in the gases in solution in rain water, in sea water, and even in the water of the Thames. J. J. S.

2025. *Molecular Rise of the Critical Temperature.* J. H. van't Hoff. (Chem. Weekblad, 1. pp. 98-96, Nov. 14, 1903. Chem. Centralblatt, 1. pp. 422-423, 1904.)—The author discusses the observation of Centnerszwer that when molecular quantities of non-volatile substances are dissolved in liquid ammonia or sulphur dioxide, the critical temperatures are raised to about the same extent in both cases [see Abstract No. 829 (1904)]. For liquid ammonia the molecular elevation of the critical temperature is found to be 219, and for sulphur dioxide 724. Starting from the osmotic pressure of the solute, the author shows theoretically that the relative molecular elevation of the critical temperature is proportional to the molecular weight of the solvent. From the law of Deprez and Trouton, it is further to be expected that the law of the molecular elevation of the boiling-point would hold more

exactly for corresponding temperatures than for the boiling-points themselves. Generalisation of the considerations here brought forward cannot be made, owing to the lack of experimental data. T. H. P.

2926. *Radiation in the Solar System.* J. H. Poynting. (Nature, 70, pp. 512-515, Sept. 22, 1904. Address delivered at the Cambridge Meeting of the British Association, Aug. 28, 1904.)—Assuming the emissivity of a black surface to be 1.27×10^{-13} calories per sec. per sq. cm., where t denotes absolute temperature C., and the radiation from the sun at the earth's distance to be $\frac{1}{4}$ cal. per sec. per sq. cm., the author deduces estimates [see Abstract No. 1082 (1904)] of the average temperatures of the sun and its nearest four planets. He then discusses the pressure due to radiation and the very important effect of size upon the relation between the sun's radiation-pressure and its gravitative pull on a body, showing that if the body is a sphere with the earth's density, the former exceeds the latter if the diameter is less than 10000 cm. The application of these principles to questions as to comets' tails, the aggregation of small meteorites and their falling into the sun or expulsion into outer space, is pointed out. R. E. B.

2927. *Thermochemistry of Theory of Electrolytic Dissociation.* J. W. Richards. (Amer. Electrochem. Soc., Trans. 4, pp. 137-150, 1908.)—The author assumes that ionisation is not a process by which a compound is resolved into its constituent elements, but that what it does is to bring a compound into a peculiar and most perfect state of combination. The heat of ionisation of a compound is the heat necessary to resolve its dissolved non-ionised molecule into its ions, and this has nothing to do with the heat of formation of the compound. The ionisation heat of an element is the heat given out in changing it from a free, molecular element into the state of a combined, dissolved ion. On this basis the author prepares tables of thermochemical constants (ionisation heats of bases and acid radicles), from which it can be seen how much each component of a salt contributes to the heat of formation of the compound in dilute solution. The process of neutralisation does not consist in the union of the hydrogen and hydroxyl ions to form water. When, for example, sodium hydroxide and hydrogen chloride come together in solution, the components Na, OH, H, and Cl are already in a state of most perfect combination, so that no further combination can take place. The process of neutralisation consists wholly of the passage of the combined hydrogen and hydroxyl from their condition in dilute solution, where they exert osmotic pressure, into a liquid state, where practically no osmotic pressure is exerted. The heat of neutralisation must therefore be numerically equal to the heat of condensation of water vapour, and this is here equal to the amount of heat necessary to convert $2\text{H}_2\text{O}$ in the liquid state into vapour with a pressure of 6.19 atmospheres. Taking into account the external work, this amount of heat is 13,700 cal., which agrees with the heat of neutralisation. In a similar manner the heat of formation of an ionised water molecule in dilute aqueous solution may be calculated, the number obtained (58,221 cal.) being identical with the heat developed when H_2 and O_2 combine to form water vapour under a pressure of 1 atmosphere. T. H. P.

2928. *ψ -Surface, where Binary Mixture behaves as a Pure Substance.* J. E. Verschaffelt. (Konink. Akad. Wetensch. Amsterdam, Proc. 12, pp. 649-668, March 23, 1904. Translated from Verslag van de gewone Vergadering

der wis-en Natuurkundige Afdeeling, Feb. 27, 1904.)—The author develops equations for the ψ -surface and the border curve on it, under these conditions: The latter satisfies the law of corresponding states to a first approximation. Equations for isobars are obtained and compared with the observations of Quint on hydrogen chloride and ethane. H. H. F. H.

2929. *Thermochemical Considerations*. A. Quartaroli. (Gazzetta Chim. Ital. 34. 1. pp. 293-323, 1904.)—The author attempts to apply the principles of vectors to thermochemical calculation, especially with reference to heats of combination. In this way he arrives at the following laws: (1) If two elements, A and B, are capable of yielding two compounds, AB and AB₂, the coefficient by which it is necessary to multiply the heat of formation of AB to obtain the heat developed in the reaction AB + B will be the smaller as the heat of formation of AB becomes greater. (2) If two elements form different compounds of the types AB, AB₂, ... AB_n, the heat developed in the successive combinations tends to become constant, and can only vary appreciably in the case of the first compound. (3) If, however, A is not an element, but a moderately complex radicle, and B an element or radicle much less complex than A, a slight decrease occurs in the heat developed in the reactions A + B, AB + B, &c. T. H. P.

2930. *Chemical Equilibrium and Fall of Temperature*. W. Nernst. (Boltzmann Festschrift, pp. 904-915, 1904.)—When a gaseous system capable of reversible change is contained in a cylinder, the temperature of which varies considerably from one end to the other, the equilibrium depends on this difference of temperature, since diffusion proceeds continually, and the rate of diffusion and the velocity of reaction influence the equilibrium. The conditions prevailing are very similar to those existing in Deville's experiments with a hot-cold tube, as is shown by the formulæ deduced. In such a system, owing to the continual diffusion acting against the temperature head, the ordinary heat-conduction of the gaseous mixture is accompanied by another form of conduction, which is mathematically developed. From the author's results for the system, $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$, values are calculated for the thermal conductivity of nitrogen peroxide at various temperatures, which are in good agreement with the observed numbers. T. H. P.

2931. *Molecular Attraction*. II. J. E. Mills. (Journ. Phys. Chem. 8. pp. 388-415, June, 1904.)—The author deduces the equation—

$$(L - E_1)/(\sqrt{d} - \sqrt{D}) = \text{a const.}$$

[see Abstract No. 2062 (1902)], in order to test the assumption that the attraction between the molecules of any particular substance obeys the law of gravitation, i.e., whether it varies directly as the product of the masses, inversely as the square of their distance apart, and does not vary with the temperature. Of the twenty-one substances examined by the author eleven are from 0° C. to the critical temperature, in reasonably perfect agreement with the above equation, when allowances are made for the errors of observation and for the multiplication of such errors in the calculation. In five of the substances the divergences all occur at such points and are of such magnitudes that they may be easily due to the errors of observation. One substance, stannic chloride, fails to agree with the equation. It was not

supposed that the equation would be applicable to the associated compounds, water, methyl, ethyl, and propyl alcohols, and acetic acid; but within wide limits the agreement of all these substances, except the last, is such as to suggest the conclusion that the molecular association here dealt with is caused by the molecular attraction under consideration. *Stroobant and T. H. P.*

2932. *Coefficient a of Rectilinear Diameters.* E. Mathias. (Comptes Rendus, 189, pp. 859-861, Aug. 1, 1904.)—On the basis of Dewar's experimental determinations [see Abstract No. 1445 (1904)], the author calculates the values of the constant a for several gases; the numbers obtained are, for oxygen 0.718, for nitrogen 0.685, and for hydrogen 0.24. The low value for hydrogen is remarkable, and shows that the laws of corresponding states are not applicable to all substances as a whole. It is further shown from the values for a number of compounds and elements that the constant a is proportional to the square root of the critical temperature. To high values of a (near 1) correspond substances whose critical temperatures may differ by several hundreds of degrees, while very low values of a can only be given by compounds with very low critical temperatures. *T. H. P.*

2933. *New Solid Solutions.* G. Brunì and A. Trovanelli. (Accad. Lincei, Atti, 13, pp. 178-183, Aug. 7, 1904.)—From cryoscopic experiments on mixtures of some thio-compounds with the corresponding oxygen ones, the author deduces that for fatty compounds those containing the group $>C-SH$ form solid solutions with the corresponding oxygen derivatives in which the group $>C-OH$ exists, but no solid solution is produced between a compound containing the group $>C=S$ and the corresponding one with $>C=O$. Thus, acetic acid and urethane form solid solutions with thio-acetic acid and ethyl thio-carbamate respectively, but none occur with acetamide and thio-acetamide, or urethane and ethyl sulpho-carbamate. The above rule does not hold for aromatic compounds, no solid solution being obtained with phenol and thio-phenol. Evidence of the formation of a solid solution between *p*-fluoronitrobenzene and *p*-chloronitrobenzene has been obtained, showing the first case of isomorphism yet discovered between fluoro- and chloro-organic compounds. *W. H. S.*

2934. *Opalescence near the Critical State.* F. G. Donnan. (Chem. News, 90, p. 189, Sept. 16, 1904. Paper read before the British Assoc. (Section B) at Cambridge, 1904.)—The author assumes that the sign of the surface tension changes at some small value of the radius of curvature near the critical point. It is further assumed that this critical radius increases with increasing temperature. Such conditions might cause one phase to be very finely distributed through the other and be accompanied by opalescence. The main ideas are due to van't Hoff. *H. H. F. H.*

REFERENCES.

2935. *Kinetic Theory of Gases.* A. Liénard. (Journ. de Physique, 2, pp. 677-686, Sept., 1903.)—An adverse criticism of the theory, with reasons given. *R. E. B.*
2936. *Heat of Fusion of Ice.* A. W. Smith. (Phys. Rev. 17, pp. 193-232, Oct., 1903.)—A much fuller account of the experiments described in Abstract No. 1970 (1904). The corrected value of the heat of fusion of very pure ice is given as 834.21 ± 0.08 joules in terms of the Clark cell at 1.484 volts at $15^\circ C$. *L. H. W.*

2937. *Saturation-Pressure of Vapours.* L. Grätz. (Zeitschr. Math. Phys. 49. pp. 289-297, 1903.)—By equating the thermodynamic potentials of a liquid and its vapour and introducing certain approximations the author deduces the Rankine-Dupré formula $f = aT^{-c}e^{-b/T}$ for the saturation-pressure f at absolute temperature T , wherein the constant c is definitely related to the specific heat. The assumption of van der Waals' characteristic leads to the same formula with f multiplied by $\exp(-f/T)$ raised to a small power; and this agrees with Cailletet and Collardeau's experiments on steam with maximum divergence of 1.8 per cent. R. E. B.

2938. *Thermal Lines for Carbon Disulphide.* T. M. Gardner. (Frank. Inst. Journ. 156. pp. 291-296, Oct., 1903.)—A table is given of the pressure, density, total and latent heats, entropy, &c., of saturated CS_2 between 32° and 315° F., pounds and feet being taken as units. Curves are then drawn to represent these magnitudes with temperatures as abscissæ, and equidifferent isometrics, lines of constant pv , lines of constant wetness (which are represented by $pv^{1.068} = \text{const.}$), &c., for the mixed liquid and vapour phases, are plotted on a $\theta\phi$ -diagram. R. E. B.

2939. *Fusibility of Mixtures of Sulphur and Bismuth.* H. Pélabon. (Comptes Rendus, 137. pp. 648-650, Oct. 27, 1903.)—The author determines the point of incipient solidification of mixtures of bismuth and sulphur, containing increasing proportions of sulphur up to 4 atoms to 3 atoms of bismuth, beyond which some sulphur always remains uncombined whatever the temperature may be. Plotting the results obtained on a curve with solidification temperatures as ordinates and percentages of sulphur as abscissæ, the curve consists of three straight lines, which are less steep as the percentage of sulphur increases. Starting from 255° , the solidifying point found for pure bismuth, the first angular point occurs with a mixture of one atom of bismuth with $\frac{1}{3}$ atom of sulphur, which commences to solidify at 435° , and the second angular point with a mixture corresponding to bismuth proto-sulphide, BiS , which solidifies at 685° . W. H. St.

2940. *Heats of Combustion of Organic Compounds as Additive Properties; Alcohols, Phenols, Ethers, Aldehydes, and Ketones.* P. Lemoult. (Comptes Rendus, 137. pp. 515-517, Oct. 5, 1903.)—By giving the values 51, 130, and 210 cal. respectively to the influences exerted, by single, double, and triple linkings of carbon to carbon, on the molecular heats of combustion of hydrocarbons, and of 53 cal. to that due to carbon linked to hydrogen, it is possible to calculate the molecular heats of combustion of hydrocarbons. Further, the same may be done for oxygenated compounds. For primary and secondary saturated alcohols, the influence of the group $\text{C}\cdot\text{OH}$ is 8 cal., while for phenols and saturated tertiary alcohols it is 2 cal., and for unsaturated alcohols - 4 cal. In saturated ethers the group $\text{C}\cdot\text{O}\cdot\text{C}$ has the value 18 cal., and in unsaturated ethers 6 cal. The influence of the carbonyl group is 12 cal. in saturated aldehydes, 6 cal. in saturated ketones, whilst in the corresponding unsaturated compounds these values are diminished by 12 cal. Calculations on these bases give results in agreement with the experimental values. T. H. P.

2941. *Calculation of the Heat of Combustion of Nitrogenous Organic Compounds.* P. Lemoult. (Comptes Rendus, 138. pp. 900-902, April 11, 1904.)—By attributing the value 16.5 cal. to the group $\text{C}\cdot\text{N}$; and subtracting from it 10 cal. for each $\text{N}\cdot\text{H}$ group, the expression for the molecular heat of formation of the compound $\text{C}_x\text{H}_y\text{O}_z\text{N}_m$ becomes $102x + 55/2 \cdot y + 16.5m - 10a - 2\phi$, ϕ having the value 55 cal. for amides, imides, &c., and a being the number of hydrogen atoms attached to nitrogen. The author calculates the molecular heats of combustion of a number of amines, amides, imides, nitriles, and compounds with nitrogen in the ring, the results agreeing closely with the experimental values. [See also Abstract No. 327 (1904).] T. H. P.

2942. Calculation of the Heats of Combustion of Organic Acids, Anhydrides, and Esters. P. Lemoult. (Comptes Rendus, 137. pp. 656-658, Oct. 27, 1903.)—The heat of combustion of a saturated organic acid, anhydride, or ester is a linear function of the number of carbon atoms in the molecule, and is expressed by the equation $\gamma = 157x + A$, where γ represents the heat of combustion, x the number of carbon atoms in the molecule, and A a constant varying in value with the nature of the compound. For monocarboxylic and dicarboxylic acids, A has the values -106 and -212 respectively, and for esters, -90 .
T. H. P.

2943. Heat of Combustion of Organic Compounds. J. Thomsen. (Zeitschr. Anorg. Chem. 40. 2. pp. 185-193, July 8, 1904.)—The author points out that the theory put forward by Lemoult [see preceding Abstract and No. 327 (1904)], which states that the heat of combustion of a hydrocarbon depends only on the number of hydrogen atoms contained in the molecule and on the number of linkages between the carbon atoms, is not new, as the formula used by Lemoult is practically identical with one given in the author's "Thermochemische Untersuchungen." Lemoult's main error, lies in the fact that he calculates the heat of combustion of any hydrocarbon irrespective of whether it is solid, liquid, or gaseous, and on this depend the magnitudes of the constants used. The data quoted by Lemoult are also very largely erroneous.
T. H. P.

2944. Specific Heat of Solutions. C. Helmreich. (Beibl. Ann. d. Physik, 28. 7. pp. 397-399, 1904. Extract of Dissertation, Erlangen, 1903.)—Deals with the specific heats of glycerine and urea in ethyl and methyl alcohol; cadmium iodide, bromide, and chloride in water, and cadmium iodide and bromide in ethyl alcohol.
F. S.

2945. Heat of Vaporisation of Aniline. W. F. Luginin. (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 672-679, 1904.)—The author replies to the criticisms of Kurbatoff [see Abstract No. 321 (1904)], who obtained values $2\frac{1}{2}$ per cent. greater than that given by the author for the heat of evaporation of aniline. Further measurements of this magnitude yield the values 104.09, 103.57, and 104.49, having the mean 104.04, which agrees well with the number (104.0) previously given by the author (*loc. cit.*).
T. H. P.

2946. Mercuric Nitrite and its Decomposition by Heat. P. C. Rây. (Chem. Soc., Journ. 85. and 86. pp. 523-527, April, 1904.)—When a solution of mercuric nitrite, obtained by the double decomposition of mercuric chloride and silver nitrite, is concentrated in vacuo over sulphuric acid, it yields the normal salt, mercuric nitrite; and when this salt is heated at 100° it breaks up in two ways, as indicated by the equations $\text{Hg}(\text{NO}_2)_2 = \text{HgO} + \text{N}_2\text{O}_3$ and $\text{Hg}(\text{NO}_2)_2 = \text{HgNO}_3 + \text{NO}$.
A. F.

2947. Mechanical Equivalent of Chemical Reactions and the Efficiency of Heat-Motors. M. Cantor. (Phys. Zeitschr. 5. pp. 379-383, July 1, 1904. Physik. Institut, Würzburg, April, 1904.)—The efficiency of a heat-engine depends essentially on the chemical transformations that occur, and no general formula can be laid down for it. Such formula can only be given for the sum of the work done and heat produced in a chemical transformation, which together may be called the mechanical effect of the transformation. This formula is indicated, and a process of combustion is described and worked out in full in which with great approximation the maximum amount of work possible is realised.
R. E. B.

2948. Liquefaction of Gas Mixtures. F. Caubet. (Zeitschr. Phys. Chem. 49. pp. 101-116, July 26, 1904. From the French.)—This is a continuation of the author's previous work, in which he discusses the relationships for mixtures of carbon dioxide and nitrous oxide [see Abstract No. 1932 (1902)].
A. F.

2949. Comparator for Thermometers. C. W. Waidner and H. C. Dickinson. (Phys. Rev. 19. pp. 52-56, July, 1904. Abstract of paper read before the American Physical Society, April 23, 1904.)—A triple-walled water-bath, which can be used horizontally or vertically, has a water coil for rapid heating or cooling and an electric coil for steady supply of heat, and has a stirrer worked by a motor. As many as fourteen thermometers can be placed at one time in the holder in the inner vessel. Plate-glass windows are provided on opposite sides for reading. The range of temperature is 10°C . to 90°C . Temperatures can be held constant to within $\frac{1}{100}^{\circ}$ for many minutes. All necessary corrections are made. Readings are taken by a micrometer microscope. P. E. S.

2950. Critical Density. J. Traube. (Zeitsch. Elektrochem. 9. pp. 619-622, Aug. 6, 1903. Paper read before the 10 Hauptversamml. der Deutsch. Bunsen Gesell., June 3-8, 1903, at Berlin.)—For the communication see Abstracts Nos. 1981 and 2224 (1904). In the discussion, G. Tammann held to the Andrews theory, and pointed out that a finite specific heat at the critical point had not been proved. J. Traube and G. Teichner held that this had been sufficiently proved indirectly, and that compressibility could not account for the phenomena observed. H. H. F. H.

2951. Freezing-Point Curves for Binary Systems. J. C. Philip. (Chem. News, 88. pp. 196-197, Oct. 16, 1903. Paper read before the British Association (Section B), Southport Meeting, 1903.)—The author discusses the various forms of the freezing-point curves of binary systems, and especially the significance of the summits. In some cases there may be an intermediate branch which does not reach a summit, indicating the formation of a compound which is unstable at its own melting-point. When the two compounds form a dimorphous compound, while the general rule holds that for each solid form there is a branch of the freezing-point curve, it is found that the one branch envelopes the other, the two summits occurring at the same composition. T. H. P.

2952. Cryoscopic Behaviour of Halogen Compounds in Phosphorus Oxychloride. G. Oddo and M. Tealdi. (Gazzetta Chim. Ital. 33. 2. pp. 427-449, 1903.)—The authors give an account of systematic investigations on the cryoscopic behaviour of the haloid salts of the more common elements in phosphorus oxychloride. Some of the halogen salts are insoluble in, and some form compounds with, this solvent, e.g., SbCl_3 , POCl_3 ; 2SnCl_4 , POCl_3 ; AlCl_3 , POCl_3 ; BBr_3 , POCl_3 ; 2MgCl_2 , POCl_3 . With elements giving two halogen derivatives, the lower one generally has the normal molecular weight in phosphorus oxychloride, but the higher halogenated compound always undergoes more or less binary dissociation, which is sometimes complete. Excepting phosphorus pentabromide, all the compounds yielding abnormal values in phosphorus oxychloride have normal molecular weights in freezing benzene. Silicon tetrachloride and tetrabromide exhibit normal cryoscopic behaviour in phosphorus oxychloride solution. [See also Abstract No. 1380 (1902).] T. H. P.

2953. Coexistence of very Different Temperatures in Adjacent Parts of a Body due to Radio-activity. E. Solvay. (Comptes Rendus, 139. pp. 44-46, July 4, 1904.)—The author employs his theory of specific potentialisation referred to in Abstract No. 1074 (1904). J. W. P.

2954. Melting-points of Solid Chloroform, Toluene, and Ether. E. H. Archibald and D. McIntosh. (Amer. Chem. Soc. Journ. 26. pp. 305-306, 1904.)—The melting-points of pure chloroform, toluene, and ether, determined by means of the hydrogen thermometer, and the results corrected by Travers's method, are as follows: Chloroform, -63.2° ; ether, -117.6° ; toluene, -97° to -99° . L. H. W.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

2955. *Influence of Pressure of the Blast on the Electrification Produced by Bubbling Air through Water.* U. Piva. (Accad. Lincei, Atti, 18. pp. 19-25, July 3, 1904.)—The air was driven through 200 ccm. of the liquid contained in a very thin beaker connected to an electrometer of the Mascart type. When water was the liquid the electrification was always positive and its course followed that of a straight line passing through the origin of two co-ordinate axes of which the abscissa gave the pressure of the blast of air and the ordinate the displacement in millimetres of the electrometer scale (in these experiments 1 volt $\equiv$ 34 mm. deviation). Solutions of bisulphate or bichloride of quinine gave this remarkable result, viz., that the sign of the electrification is dependent on the pressure of the blast. Thus, for instance, the following data were obtained in the case of the quinine bisulphate:—

Quantity of Substance in 200 ccm of Water.	Pressure of the Blast of Air in cm. of Water.					
	10	20	30	40	50	60
	Deviations of Electrometer in mm.					
A. 0.000100 gm.	+ 29	+ 50	+ 65	+ 76	+ 87	+ 79
B. 0.000150 "	+ 16	+ 25	+ 22	+ 22	+ 14	- 1
C. 0.000175 "	+ 10	+ 15	+ 11	+ 4	- 6	- 18
D. 0.059000 "	- 1	- 6	- 8.5	- 10	- 7.5	...
E. 0.076000 "	- 1.5	- 2.4	- 4	- 2	+ 2	+ 7
F. 0.141600 "	...	+ 1	+ 2	+ 5	+ 10	+ 19

Other solutions (acetic acid, hydrochloric acid, sodium bromide, sodium potassium, tartrate, aesculin) were examined, but no further case was noticed where mere change of pressure gave a change of sign of the electrification.

D. H. J.

2956. *Collectors for the Determination of Atmospheric Dispersion.* F. Linke. (Phys. Zeitschr. 4. pp. 661-664, Oct. 1, 1903. Geophysikal. Inst. d. Univ., Göttingen, Sept. 15, 1903.)—The author has conducted comparative measurements with various collectors. From the formula $dV/dt = -Vc/C$ [see Abstract No. 1897 (1902)] the author arrives at $V = V_0(1 - c/C)^t$; C is the capacity of the collector; the charging coefficient c is, for water-drop collectors, the capacity of the water discharged during the time dt . The formula also holds for flame and radio-active collectors, provided that the number of ions discharged, and therefore also dV/dt , be proportional to the remaining p.d., and that c expresses this ratio. Calling the time required to neutralise the p.d. down to about 1 per cent., the practical charging period T , the author finds $T = 2C/0.4848c$; T and c have to be determined, and T should be small to avoid disturbances by leakage due to imperfect insulation. The experiments were made with an ordinary water-drop

collector and a hydraulic drop collector (lead tube, 2 mm. in diam., 16 m. in length), both used during balloon ascents, to water-spray collectors (so-called Kühleborn, from Mosdorf & Hochhäusler, of Berlin), a flame collector, a bismuth-polonium rod, and two radium electrodes, the radium bromide being contained in the one case in a glass tube, which was further wrapped with lead without preventing the circulation of the air in the other case. The spray collectors and the hydraulic drop collector gave by far the best charging coefficients c (from 80 to 50 against 5 or 1 for the radium electrodes), and the shortest charging periods T (10 secs., against 90 and 460 for the radium electrode, the inferior figures being those for the lead-sheathed tube). Special tests were made on the behaviour of radium collectors in disturbed air. It results that the indications of radium collectors depend to a high degree upon their shape and upon the direction and strength of the air currents, and that radium electrodes would influence the experiments in the balloon cage, even if suspended 15 and 30 m. below. Some of these objections apply to flame collectors.

H. B.

DISCHARGE AND OSCILLATIONS.

2957. *Discharging Action of Ultra-violet Light.* E. Ladenburg. (Ann. d. Physik, 12. 3. pp. 558-578, Sept., 1903. Extract from the Leipziger Inaugural Dissertation.)—As Lenard has shown, the conditions are much simpler if the sensitive surface is placed in as good a vacuum as possible. The author uses this arrangement. The results, in brief, are as follows: The fatigue shown by some metals, notably gold, silver, platinum, copper, is due to the corrosion of the surface by the light. Aluminium does not show this effect. As the polish of the surface increases, the discharge obtainable from it under specified conditions approaches a maximum. Well-polished copper gives the largest discharge, followed by brass, zinc, bismuth, in this order. For equal light intensity on the surface the current obtained is independent of the angle of incidence. The effective light penetrates nickel to a depth of 8 wave-lengths; this may explain why both Lenard and the author find that the position of the plane of polarisation is without influence. It also follows that the absorption of the light by the metal may be the most important part of the mechanism by which the discharge is produced.

R. S. W.

2958. *Slowly-moving Kathode Rays.* P. Lenard. (Ann. d. Physik, 12. 3. pp. 449-490, Sept.; 12. 4. pp. 714-744, Oct., 1903.) W. Kaufmann. (Ann. d. Physik, 18. 4. pp. 886-889, March, 1904.)—A zinc electrode is strongly illuminated by ultra-violet light, and is charged to a negative potential varying from 4-4,000 volts. The corpuscles emitted form the kathode rays. They are absorbed much more easily by solid bodies than rays with greater velocity are; gold leaf, 0.00007 mm. thick, is perfectly opaque to them. The intensity of the phosphorescent light they produce is proportional to the density of the rays. As a source of light these phosphorescence effects are extremely efficient; in some cases 1 watt for 10 Hefner units, showing that there is a very remarkable partition of energy in the different parts of the spectrum. The second paper is devoted to absorption effects. Rays are obtained which are absorbed one hundred times more than are rays under a potential of 25,000 volts. Kaufmann criticises some of these results.

R. S. W.

2959. *Effects of Radiation from an Electric Spark, and Disturbances Produced by a Solid Dielectric.* I. Schincaglia. (N. Cimento, 8. pp. 81-95, Aug., 1904.)—A terminal of each of two condensers is connected to a pole of an influence machine, a spark-gap having spherical knobs being also inserted between the same poles. The other terminals of the two condensers are united by another spark-gap having spherical knobs. The effect of the radiation from the first spark on the production of the second is observed. Also, screens are placed in various positions between the two sparks, and various dielectrics are inserted between the knobs of the second gap. The author finds that the action on a spark of the invisible rays given out by another spark is extremely complex, and varies with the differences of curvature of the knobs. With air as dielectric the helping or impeding effect is exerted on the negative electrode only, the impeding effect only being observed when the electrode is a point. The most effective part of the explosive field is the extremity of the cathode, and the different parts of the radiating spark are not equally active in emitting the effective radiations. The introduction of a dielectric such as glass or ebonite between the knobs of the detecting gap produces the greater effect on the knob of less curvature. S. G. S.

2960. *Conduction of Electricity through Mercury Vapour.* A. P. Wills. (Phys. Rev. 19. pp. 65-88, Aug., 1904. Electrician, 54. pp. 26-28, Oct. 21, 1904.)—The dark space is found to increase from 4 cm. to 6.5 cm. in a tube 5 cm. in diam., while the current increases from 1 to 5 amps. Thermocouples are fused into the tubes at different points of the positive column, and the temperature and potential measured at these points. The temperature appears to have a minimum value at a point some distance in front of the anode; and it gradually increases in value in these experiments from about 100° to 250° as the current varies from 1.25 to 3.25 amps. The anode fall of potential drops in the same circumstances from 6.5 to 4.6 volts. The drop at the cathode is nearly independent of current, and equals about 5 volts. An inductance placed in series with the tube renders it capable of being run with much smaller currents. An empirical formula is given connecting electromotive intensity, current, diam. of tube, and vapour pressure of mercury. The first decreases as the current increases. Numerous curves are given showing the results attained. R. S. W.

2961. *Ionisation Produced in Different Gases by Röntgen Rays.* R. K. McClung. (Phil. Mag. 8. pp. 357-378, Sept., 1904.)—Various gases are compared with air by a null method. A balance is first obtained with air in two cylinders which are exposed to different parts of the same beam of rays. Another gas is then substituted in one of the cylinders, and the pressure altered until a balance is again obtained. Previous investigators have shown that the ionisation produced in a gas varies as the pressure; so that, if the pressures are read when the ionisation is the same in both cylinders, the relative ionisation at equal pressures is easily deduced. It is found that this depends greatly on the kind of rays used. In hydrogen, the harder the rays the greater the ionisation produced as compared with air. In oxygen, carbon dioxide, and sulphur dioxide the opposite is the case. The general tendency appears to be for the total ionisation in the denser gas to become more nearly equal to that in the less dense one as the rays become more penetrating. R. S. W.

2962. *Contribution to Knowledge of Coherer Action.* J. Hårdén. (Phys. Zeitschr. 5. pp. 626-627, Oct. 15, 1904.)—The author's views on the cause of

coherer action—the presence of microscopic sparks [see Abstract No. 1462 (1900)]—led him to expect that a single contact in a vacuum of greatest conductivity (0.8 mm. Hg) would work better than at atmospheric pressures. Using an exhausted tube with electrodes 0.2 mm. apart, connected one each to high wire and earth, it was found that a relay circuit did indicate that the waves were sufficient to cause a bridging of the gap, and the recovery was automatic on the waves ceasing. With a mercury vapour lamp and 200 volts applied, a similar effect was observed, but owing to the high resistance of a cold lamp, very strong waves were necessary. No particulars as to sensitiveness of the first method are given. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2963. *Absolute Potential of the Calomel Electrode.* W. Palmaer. (Zeitschr. Elektrochem. 9. pp. 754-757, Sept. 8, 1903. Elektrochem. Laborat. der techn. Hochschule, Stockholm, June, 1903.)—The method used by the author in measuring the absolute potential of the calomel electrode is based on Nernst's theory, from which it follows that the mercury drops of a dropping electrode will be charged positively in a solution in which the osmotic pressure of the mercury ions is greater than the solution pressure of mercury, and negative in the opposite case. If the concentration of the mercury ions in solution is gradually diminished, it will be found that at a certain point the direction of the current flowing between the dropping electrode and a stationary electrode of mercury changes; the difference of potential between mercury and the solution then vanishes. The e.m.f. of such a cell will then be the absolute potential of the calomel electrode, a correction being made for the small difference of potential at the junction of the two electrolytes. Two solutions—one containing potassium cyanide and the other hydrogen sulphide—giving no potential difference with mercury, yield for the potential of the N/10 calomel-electrode the values -0.574 and 0.570 volt. T. H. P.

2964. *The Aluminium Electrolytic Condenser.* C. I. Zimmerman. (Amer. Electrochem. Soc., Trans. 5. pp. 147-162; Discussion, pp. 162-170, 1904. Elect. Rev. N.Y. 44. pp. 657-660, April 30, 1904.)—The author first refers to the asymmetry of the Al cell due to the film, and points out the factors concerned in the film production—electrolyte, impressed voltage, and temperature. The thickness of the film from interference measurements ranges from 0.000005 cm. to ten times that amount. This thin layer can be considered as an asymmetric dielectric which is capable of holding + charges only on the side in contact with the metal, and - charges only on the side in contact with the liquid. The specific inductive capacity of the film, from Mott's values, is very high for a solid (about 80). An electrolytic cell, both electrodes of which are coated aluminium, will prevent a direct-current from flowing in either direction, but an alternating current allows a considerable condenser current to flow. The theory of the actions is then discussed, perfect asymmetry and absence of polarisation pressures and of cell losses being assumed. The cell is compared with the tin-foil condenser as regards its condenser action, and it is observed that the aluminium condenser may be considered to be like two tin-foil condensers of equal capacities placed in series, but here one film is being charged while the other is discharging, in place of both charging or discharging together as in tin-foil condensers. The losses are then considered. These are (1) film losses; (2) C/R losses;

and (8) electrolytic decomposition losses. The first include leakage losses and a loss proportional to the frequency; this latter at the higher commercial frequencies is the largest loss in the cell. The breakdown point under suitable conditions with a two-electrode condenser has been able to be carried above 1,250 volts effective alternating, but the efficient limit is not much over 150 volts. The chief practical disadvantage is the very large capacity per unit of surface (for 110 volts roughly $\frac{1}{4}$ to $\frac{1}{2}$ microfarad per sq. in. of Al plate). The efficiency of such cells as condensers is stated to be from 98 to 97 per cent., efficiencies over 95 per cent. being obtainable on continuous operation. The weight, volume, and cost of such condensers are considerably smaller than for tin-foil condensers of the same capacity, but where the voltage rises much above the efficient voltage for a single cell the advantages are not so marked. Voltage rises due to resonance would simply break down the film, which would repair itself unless the puncturing be continued for a lengthened period. [See also Abstract No. 2174B (1904.)]

L. H. W.

2985. Absorption of Energy in Condensers. R. F. Earhart. (Phys. Rev. 19. pp. 8-17, July, 1904.)—To ascertain the former in an alternating current we need to know the factors current, e.m.f., and lag. By an adaptation of Rayleigh's phasemeter to the case of a condenser, it is possible to determine each of these factors. A soft-iron needle lies midway between two coaxial coils. In the circuit of coil (1) is a high resistance. This is the e.m.f. circuit. In the circuit of coil (2) is a condenser and reversing key. This is the current circuit. The efficiency of a condenser is the ratio of work done by condenser in discharge to work done in charging. This ratio is obtained by integrating the areas of positive and negative loops. Using a series of waxed-paper condensers the efficiency in ten cases varies between 96.5 and 97.8 per cent.

P. E. S.

2986. Testing Mica Condensers. E. B. Rosa and F. W. Grover. (Phys. Rev. 19. pp. 59-60, July, 1904. Abstract of paper read before the American Physical Society, April 23, 1904.)—Four characteristics of the condensers should be known: (1) Change of capacity with time of charge; (2) magnitude of absorbed charges; (3) leakage resistance; (4) temperature coefficient. If the time of charge be greater than half a second a ballistic galvanometer is used. If the period is small, as in alternating currents, the alternating-current bridge method is used, thus the range of the time of charge is from 1/360 sec. to 20 sec. Results are given. Residual charge is shown by a very sensitive ballistic galvanometer. In this way it is possible to show as many as five consecutive residual charges, the last being as much as 16/100,000 of the original charge. Leakage is found by filling up periodically through a ballistic galvanometer at such a rate as to just make good loss by leakage. Temperature coefficient is very small for mica condensers.

P. E. S.

2987. Thermo-electric Force of Nickel Nitrate in Organic Solvents. J. F. Meyer. (Phys. Rev. 19. pp. 158-165, Aug., 1904.)—The thermo-electromotive force of a solution of nickel nitrate in aniline or pyridine with platinum electrodes is zero even when the difference of temperature between the two electrodes is 80° C. In solutions of nickel nitrate in alcohol the heated electrode is first positive, but becomes negative towards the cold electrode as the temperature difference increases; in acetone solutions of nickel nitrate, how-

ever, the heated electrode is always positive. For concentrations varying from 1/10 to 1/50 normal the e.m.f. is independent of the concentration. Polarisation effects cannot be avoided, and are large enough to mask the thermal effects, so that a method in which no current is passed alone gives satisfactory results.

2968. *Peltier Effect at the Neutral Point of a Thermo-electric Couple.* M. La Rosa. (Accad. Lincei, Atti, 18. pp. 167-178, Aug. 7, 1904.)—The author points out that the experiments of Budde and Battelli by no means prove the Peltier effect to be zero at the neutral point, and to determine this question he has made a very careful investigation of the value of the Peltier effect in the neighbourhood of the neutral point for a zinc-platinum junction. He employs a bar of pure zinc bent in the form of a V, the ends of which are connected by iron and platinum wires. After determining the neutral point of the zinc-platinum couple, a known current is passed for a minute round this circuit, then interrupted, and the zinc-iron circuit, containing a sensitive galvanometer, rapidly completed, the deflections of the galvanometer being noted. The experiment is then repeated with the current in the zinc-platinum circuit reversed. The difference between the deflections of the galvanometer in the two experiments is proportional to the difference of temperature produced between the junctions by the Peltier effect. Readings have been taken at temperatures from 19° to 46.5° C., the neutral point being found to be 86.6°, and a curve plotted with temperatures for abscissæ, and the corresponding differences in galvanometer deflection as ordinates, cuts the temperature axis at very slightly above 86.5°, thus showing that the difference between the neutral point and the temperature at which the Peltier effect becomes zero is within the limits of experimental error.

2969. *Thermo-electric Inversion and Neutral Point.* G. de Metz. (Comptes Rendus, 189. pp. 447-450, Aug. 22, 1904.)—According to previous researches made by Kelvin, Avenarius, Tait, and others, the following relations hold between T_{inv} , the temperature of inversion, and T_n , the temperature of the neutral point: $T_{inv} = 2T_n$, $T_{inv} = t_1 + t_2 = \text{a constant}$, t_1 and t_2 being the temperatures of the two functions of the thermo-electric couple at the moment of inversion when the current is zero. The author has experimented with various couples—Pt-Au, Pt-Cu, Pt-brass, Pt-Pb, Pt-Al, Pt-Zn, Ag-Zn, Pt-Ag, Pt-brass—and it is only for the couple Pt-Zn that the above two equations hold exactly. For all the other couples T_{inv} changes in value as the temperature t_1 of one of the contacts decreases progressively to the temperature of liquid air, the other temperature t_2 consequently increasing progressively. Most of the couples show that the value of T_{inv} has, in general, a tendency to increase as the temperature t_1 is lowered, but the couple Ag-Zn is an exception, and acts the reverse way. The value of T_n , the neutral point, however, remains perfectly constant as t_1 is lowered.

2970. *Application of the "Arnò" Detector of Hertzian Waves.* P. Colabich. (Elettricità, Milan, 28. pp. 452-455, July 22, 1904.)—The apparatus used by Arnò to detect electromagnetic waves is described [see Abstract No. 1156 (1904)]. The author has experimented with various antennæ and coils to find the condition of maximum sensitiveness. With antennæ 2.4 m. high at a distance of 7.4 m. the greatest effect is produced with 10 m. of wire in the coil which surrounds the steel cylinder, and 8.8 m. in the coil attached to the

transmitting antenna; and further, for each turn of wire on the former coil the maximum effect is produced with an equal length of wire in the latter. A similar effect was observed with antennæ 4.2 m. high, the maximum effect still being produced with a spiral of 10 m. for the receiver. The author was prevented by want of space from using longer antennæ. Iron wires were tried for the coils, but the effect was always less than with copper. The experiments were repeated with frequencies of the rotating magnetic field varying from 42 to 12, but the critical length of spiral was always the same.

S. G. S.

2971. *Experiments with the Electrolytic Wave-detector.* V. Rothmund and A. Lessing. (Ann. d. Physik, 15. 1. pp. 198-212, Sept., 1904. Physik-chem. Inst. d. k.k. deutschen Universität, Prag, July 19, 1904.)—With a view to the better understanding of the phenomena exhibited by electrolytic detector cells, the authors have carried out a series of experiments, using a point electrode 0.025 mm. diam. of not too great sensitiveness. The arrangement adopted is fully described, and consisted in employing a Blondlot type oscillator with a not-earthed, rectangular transmitter circuit and an insulated receiver circuit of similar form, placed 20 cm. above the transmitter, and provided with a pair of Lecher wires 4 m. long. The measurements were made as follows: The polarising circuit was closed, and after 1 min. the galvanometer deflection read (current through cell); the coil was then started, and after 30 sec. a reading again taken. The coil was then stopped, and again after 30 sec. a reading taken. With small currents the third deflection did not differ much from the first, showing little after-effect. The results are then given in the form of tables, where with sulphuric acid as electrolyte the p.d. of the point electrode (compared with a standard Calomel electrode) without and with waves, and the current without and with waves, are tabulated, with the point as anode and also as kathode. Similar tables are given for nitric acid as electrolyte. From the tables it is seen that the current is greatly increased by the waves whether the point is anode or kathode (less in the latter case). The effect on the p.d. is much less, but the p.d. is always decreased (except in the later experiments without external polarising battery, in which case the p.d. was always increased). The relative increase in the current is greatest for polarising p.d.s less than the decomposition p.d. The waves also produce an effect when no current is passing through the cell, as such an excited cell gives a larger-than-normal deflection when the polarising p.d. is then applied. Experiments are there described on the effect of concentration of the electrolyte, and a number of highly interesting curves given. The maximum effect is obtained with greatest conductivity (with H_2SO_4 , at 80 per cent. acid). The action giving rise to the effect is next considered. Reich has already [see Abstract No. 1756 (1904)] shown that the view of Fessenden that the effect is due to a bolometer working is incorrect, and the authors have confirmed this by employing liquids having a negative temperature coefficient at higher temperatures (such as hypophosphorous acid). Up to 94° a distinct increase of current under the influence of the waves was observed, although a decrease should have been noticed had the effect been a bolometric one. Reich's view that dissolution of the platinum takes place is not fully accepted, since the effect occurs also with other metals and with cathodic polarisation. The explanation offered by the authors is that the cell acts asymmetrically, and that the effect requires a certain current density—hence the diminutive electrode. The observed phenomena cannot be explained by resistance changes due to heating effects of the current, while

the view that the effect is dependent upon a depolarising effect is a satisfactory one. The authors' very definite results with the small electrode as kathode certainly contradict the statement of de Forest. [See Abstract No. 2689b (1904).] L. H. W.

ALTERNATING CURRENTS AND MAGNETISM.

2972. *Magnetisation of some Alkali Metals.* A. Bernini. (N. Cimento, 7. pp. 441-447, June, 1904.)—For his work the author has used a slightly modified form of the apparatus employed by Curie and Chéneveau to determine the magnetic constants of radium salts. He finds that sodium, potassium, and lithium are feebly magnetic metals, with the following coefficients of specific magnetisation respectively, viz., 0.5438×10^{-6} ; 0.682×10^{-6} ; 0.8886×10^{-6} . These coefficients fall with the temperature and exhibit no sharp variations on change of state. D. H. J.

2973. *Mutual Influence of Magnetism and Elasticity.* H. Rensing. (Ann. d. Physik, 14. 2. pp. 363-377, June, 1904. Extract of Münster Inaugural Dissertation with Appendix by A. Heydweiller.)—Heydweiller (Ann. d. Physik, 4. p. 12, 1903) showed from thermodynamic consideration that the following relation holds: $\frac{\partial E}{\partial H} = -\frac{E^2}{4\pi} \frac{\partial B}{\partial p}$. The author brings together experimental evidence as to the values of $\partial E/\partial H$, and he also calculates values for $\partial E/\partial H$, using the factors on the right-hand side of the equation. Throughout a considerable experimental range the equation is proved to be correct within experimental errors. In the equation E is the length-modulus of elasticity, H the field used, B the induction, and p the end force (+ or -) employed in the elasticity measurements. P. E. S.

2974. *Magnetic Expansion of Heusler's Alloys.* L. Austin. (Deutsch. Phys. Gesell., Verh. 8. 14. pp. 211-216, July 30, 1904. Physikalisch Technische Reichsanstalt, July 1, 1904.)—These alloys are composed of manganese, aluminium, and copper. On subjecting a rod to a longitudinal field, one end being fixed, the free (lower) end actuates the short arm of a lever whose long arm acts on a mirror suspended bifilarly, i.e., in Kelvin's method. By such means a magnification of 400,000 is produced. The curves showing the relation of length-change to field are somewhat like the well-known curves connecting induction and field. The greatest expansion observed is 11×10^{-7} of the length in a field of 400 units. One curious result is that in very strong fields there is a gradual contraction which seems to vary as the square of the field. P. E. S.

2975. *Temperature Coefficient of Permeability.* E. P. Harrison. (Phil. Mag. 8. pp. 179-205, Aug., 1904. Inaugural Dissertation, Zurich University.)—A thin wire of iron or nickel is placed in a thin platinum tube 2 mm. diam. and 20 cm. long, and insulated from it. Copper leads carry current to the platinum tube, which is then heated to any desired temperature. This temperature is measured by Callendar's method. A magnetising coil surrounds the apparatus, and a water-jacket lies inside the coil. The inner apparatus is exhausted to a high vacuum to avoid oxidation at high temperatures. A magnetometer is placed near for the measurement of magnetic induction. A very complete set of curves for iron and nickel is drawn, showing the relation of field, induction, and temperature to one another. P. E. S.

2976. *Variation in Resistance of Bismuth in a Magnetic Field.* C. Carpini. (Accad. Lincei, Atti, 18. pp. 159-166, Aug. 7, 1904.)—A coil of bismuth wire is used, the variation of resistance being determined by observing the galvanometer deflection thereby produced, the coil being situated in one arm of a Wheatstone's net. The galvanometer scale is calibrated by noting the variation in deflection produced by altering the resistance of this arm of the net by a known small amount. The relation between H , the strength of magnetic field, and R , the resistance of the wire, is found to be—

$$H = \frac{\delta R}{R} (4.6818 + 5727.3) 10^4.$$

Field strengths up to 2,000 units are employed, and the wire is at right angles to the field. The effect of varying the inclination of the wire to the field is also investigated, and it is found that the relation of change of resistance to inclination of wire to field is sinusoidal. It is further found that the phenomenon exhibits no hysteresis effect. There is, however, a time lag, which is shown by using an alternating magnetic field; in which case the quantity $\delta R/R$ is much smaller for each value of the field than for the corresponding constant field. S. G. S.

2977. *Effects of Oscillating Magnetic Fields.* F. Piola. (Eletttricista, Rome, 18. pp. 233-235, Aug. 15, 1904.)—The peculiar hysteresis effect of a rapidly oscillating magnetic field superposed on the chief cyclic field is described, and it is pointed out that an increase in hysteresis due to the superimposed field is to be expected, and not a diminution, as was supposed by certain experimenters. The experiments of R. Arnò [see Abstract No. 1156 (1904)] are in complete accord with this, but those of J. A. Ewing and L. H. Walter are only partially so. The second part of the article deals with the magnetisation produced by alternating currents of high frequency, such as are produced by the discharge of a Leyden jar. A specimen of iron or steel is subjected by the author to an artificially damped alternating magnetic field, the damping being produced by inserting resistance in the magnetising current circuit on each reversal, the resistance being so chosen that succeeding amplitudes are in geometrical progression. The specimen is first magnetised by a steady field, and then subjected to the alternating field, whose maximum is always less than the value of the steady field. With a given decrement the resultant magnetisation varies in amount and sign with the amplitude of the oscillatory field, the curve resembling somewhat a sine curve. The effect increases rapidly with increasing decrement of the oscillating field. Hence, since the magnetic effect of the induced Foucault currents increases from the surface to the axis, the resultant effect of the magnetising field decreases from the surface to the axis, and the result of the rapidly oscillating magnetic field is to produce a stratified magnetic condition, such that the residual magnetisation alternates in sign from surface to axis, the effect being greater the greater the decrement of the oscillating field. This explains the results obtained by Savary in 1828, and also those of Rutherford and of Veillon.

2978. *Probable Cause of the Yearly Variation of Magnetic Storms and Aurora.* N. Lockyer and W. J. S. Lockyer. (Roy. Soc., Proc. 74. pp. 90-95, Aug. 10, 1904.)—Having established the inter-connection between solar prominences, solar activity, and magnetic disturbances, the authors point

out that, as the axis of the sun is inclined to the ecliptic, the south pole of the sun is most turned towards the earth about March 6, and the north pole about September 5. Thus our equinoxes occur in the months when one of the solar poles is turned towards the earth, and the solstices when the solar poles are in a neutral position with regard to the earth. From Ellis's observations we know that magnetic disturbances are most frequent at Greenwich and Paris about the equinoxes, and auroræ most frequent in Scotland and Scandinavia about September or October and March or April, and that the latter autumn maximum is delayed (to October) and the spring maximum hastened (to March) in our higher latitudes where the mid-winter minimum vanishes. The seasonal variations in the frequency of magnetic storms and auroræ, therefore, appear to depend upon the position of the sun's axis, and groups of years when the polar regions of the sun are most disturbed synchronise with epochs when the excess of the equinoctial over the solstitial frequency of magnetic storms is greatest. H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

2979. *Electric Currents in Tissues of Animals and Plants.* N. Cybulski. (Acad. Sci. Cracovie, Bull. 8. pp. 622-629, Oct., 1908.)—The electric currents in tissues are due to diffusion and osmosis of electrolytes, the structure of the membranes of the protoplasm being such that the positive ions collect on the surface and the negative in the interior. The author filled guts of frogs with gelatine impregnated with electrolytes, and dipped the gut afterwards into a gelatine solution of a different concentration. The resulting concentration currents did not correspond to the currents observed in muscles and nerves. When the gut was filled with gelatine and potassium ferrocyanide, however, and then dipped into gelatine and copper sulphate, any lesion of this imitation nerve caused electric currents as in nerves; in bundles of such guts the resemblance to nerves was still more marked. The author also separated three small cells by partitions of filter paper. No current was observed when the concentration of the electrolyte in the two outer cells differed from that of the same electrolyte in the central cell; but when one of the paper partitions was coated with gelatine, regular currents were noticed, and batteries could be built up in this way. This experiment had been made by Tschagowetz to explain the electric phenomena of certain fishes. The author considers that these and similar experiments lead to the conclusion indicated above. H. B.

2980. *Present State of Radiotherapy.* R. Klenböck. (Archives d'Él. Médicale, 12. pp. 488-491, July 10; Discussion, pp. 575-577, Aug. 12, 1904. Report to the Congrès de l'Assoc. Française pour l'avancement des Sciences, Grenoble, Aug. 4, 1904.)—The paper comprises (1) a review of general principles; (2) the technique of radiotherapy; (3) the special treatment in specified diseases. In the discussion, which turned chiefly upon the measurement of the amount of radiation applied, Bécclère pointed out that if the quality of the Röntgen rays is determined by the Benoist radio-chromometer and the amount by the chromo-radiometer of Holzknecht, one is in the best condition for judging as to the dose. Freund has recently suggested the use of a solution of iodoform in chloroform in place of the Holzknecht chromo-radiometer, but the colouration is too fugitive, and can furthermore be produced by rays other than the Röntgen rays. He then described the new

chromo-radiometer of Sabouraud and Noiré, based upon Villard's observation that barium platinocyanide turns to a brownish-yellow colour on long exposure to Röntgen rays, but can be regenerated by subsequent exposure to light. The exact colour produced when rays are applied of such strength that skin affections are not produced is observed, and this colour must never be exceeded. In actual use small discs of the platinocyanide, 5 mm. in diam., are used; one is exposed at the same time as the patient, but 8 cm. from the tube, the patient's skin being 15 cm. distant (quantity of radiation 4 times as great). A control disc (of the chosen tint) is compared with the exposed one, and the *séance* stopped as soon as the latter matches the control.

L. H. W.

1981. *Action of the Röntgen Rays on Leukæmic Blood.* C. Aubetin and E. Beaujard. (Revue Int. d'Électrothérapie, 14. pp. 25-28, July and Aug., 1904.)—A typical case of spleno-medullary leukaemia in a man aged 60 was treated by weekly exposures to the Röntgen rays, which were directed over the splenic region, and blood examinations were made before and after the applications. It was found that 15 min. after the *séance* there was a slight reduction in the number of white cells; two hours after, the white blood count was greater than that before the *séance*, and it continued to rise during the next 24 hours until the original figure was more than doubled. On the third day it had fallen, and it decreased gradually during the next three days, until it finally reached a point which was below the original figure. After the later *séances* the variations became less and less marked, but were of the same character. A differential count revealed the fact that the increase observed after each treatment was due to an absolute increase in the polynuclear leucocytes. No change could be detected in the structure of the white cells as the result of radiotherapy. The nucleated red cells did not appear to be notably influenced. Their absolute number remained the same. After each *séance* there was an increase, sometimes considerable, in the number of red cells.

H. W. P. Y.

1982. *Lethal Concentration of Acids and Bases in respect of Paramæcium Aurelia.* J. O. W. Barratt. (Roy. Soc., Proc. 74. pp. 100-104, Aug. 10, 1904. From the Physiologisches Institut, Göttingen.)—The method of investigation adopted for determining the lethal concentration of acids and alkalies consisted in placing paramæcia in known quantity in solutions of gradually decreasing molecular concentration, each succeeding concentration being half that of the preceding, and noting the time at which death occurred. The acids employed are divided into three groups: (a) strong mineral acids; (b) organic acids; (c) extremely weak electrolytes, such as carbonic, carboric, hydrocyanic, and boric acids. The bases employed are also to be arranged in three groups: (1) strongly dissociated metallic alkalies; (2) the feebly dissociated ammonium hydrate; (3) the extremely weak electrolyte anilin. In 0.0001 N concentration the strong mineral acids are nearly equally lethal. Acetic, lactic, and oxalic acids are more lethal, phosphoric, citric, and acetic acids are less lethal in the same concentration than those of the first group. The weak acids are more lethal in less ionic concentration than the strong acids, and the extremely weak electrolytes exhibit the smallest ionic concentration, that of phenol forming the limit of the series. When the acids employed are arranged in the order of their dissociation, the diminution in ionic concentration proceeds at a much slower rate than the increase of molecular concentration. The strong alkalies are similarly less toxic than

the weak alkali ammonium hydrate, and the latter again is considerably less so than anilin, whose ionic concentration ($4.3 \times 10^{-6}N$) is about 1/500 of that of lithium hydrate ($1960 \times 10^{-6}N$) for a nearly equal lethal effect. The metallic alkalis can be arranged in two periodic groups, the mean lethal concentration of the one (K, Na, Li) being greater than that of the other (Ca, Sr, Ba). Further, the lethal effect runs parallel to the periodic order of these metals. The considerable difference in ionic concentration both of acids and of bases, for a nearly equal toxic effect, shows that such effect is not hydrolytic in character.

H. W. P. Y.

2983. *Electropism of Roots*. A. B. Plowman. (Amer. Journ. Sci. 18. pp. 228-236, Sept., 1904.)—The author has repeated the work of Elfoing on the galvanotropism of roots, and has made further researches in order to explain the phenomena observed. If a current of electricity be passed through the water in which the roots of seedlings are growing, they, almost without exception, turn sooner or later towards the positive pole. The time required for this reaction depends upon the kind of plant, as well as upon the density of the current. In a uniform current, those plants which show most rapid normal growth of the roots are the ones which show a typical curvature most quickly. For any given kind of root there is a maximum current density at which the curvature is produced most rapidly. If the current density be raised even slightly above the specific maximum, the roots are killed before curvature can take place. This maximum differs in different plants. The maximum current density invariably kills the roots in a short time, but it is possible to adjust the current to such a strength as not to kill the roots and yet to hold them to their horizontal course against their normal geotropic tendency. The location of the greatest curvature in the root is at the point of most rapid normal elongation. A current of 0.1 milliamp. passed in an upward direction through the root of a seedling killed it in 12 hours, but when passed in the opposite direction the root is apparently unaffected. The so-called "negative galvanotropism" was not observed. A microscopic examination of the internal structure of normal and electrically curved roots reveals the fact that the cells on the concave side of the root, or the side opposite the positive pole, are killed, while those on the opposite are growing quite normally. That the effects are not of an ordinary chemical nature is proved by the fact that so long as the current density is kept constant the roots behave in precisely the same manner, regardless of the chemical composition of the electrolyte, provided always that the chemicals are so dilute as not to be directly and immediately harmful to the plants. Upon the basis of the electron theory all the phenomena of electropism are readily explained. The stream of positive electrons sooner or later kills the cells on the side of the root toward the positive pole. When the growing end of the root has become parallel to the stream of electrons it is kept in that position, since any deviation would expose the more rapidly growing side to the positive electrons, with a consequent checking of the growth and a return to the horizontal position. The negative electrons, as far as can be made out, are in no case harmful to plant protoplasm, and probably cause acceleration in growth.

H. W. P. Y.

2984. *Graphic Tracings of the Faradic and other Interrupted Currents*. H. Lewis Jones. (Brit. Med. Journ. 2284. pp. 911-913, Oct. 8, 1904. Electrician 54. pp. 108-110, Nov. 4, 1904. Paper read before the Brit. Med. Assoc., at Oxford.)—The tracings are taken by the oscillograph on a moving photo-

graphic plate, the speed of the plate being 4 m. per sec. in all cases. In considering the medical coil three separate currents must be considered: (1) The secondary current, which is alternating; (2) the interrupted exciting current (inducing or magnetising current); (3) the extra current of the primary. The diagrams show tracings of the first two only. When no coil is present the current reaches its full value at each make in a time which is not more than 1/4000 sec., but when a coil is introduced it has not reached a steady state after 1/200 sec., and is still rising when the break comes. The oscillograph shows that the vibrating hammer commonly used as an interrupter is a defective device. It does not produce clear, sharp makes and breaks, and frequently fails to make adequate contact. As each of these partial contacts is reflected in the curve of the secondary current, the secondary current of a coil thus fitted is one of great complexity, and is therefore highly disagreeable to the patient. Moreover, the rate of this type of interrupter is too slow. Induction coils with auxiliary electromagnets for operating the hammer, especially if this is heavy and vibrates up and down, also give these irregular currents of low frequency and are unsatisfactory. The effect of a core is investigated. The author's experience has convinced him that for painless or nearly painless testing of muscles the shortest impulses are best, and coils with short windings and without iron cores afford the most agreeable form of current. For diagnosis he now employs a mechanical interrupter to a continuous-current source, which gives alternating impulses instead of simple interruptions. This has the advantage of eliminating the chemical effects of electrolysis. With this instrument the current used can be measured directly, and the voltage applied and the frequency of the interruption can be regulated and measured.

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REFERENCES.

2985. *Maxwell's Theory*. E. Cohn. (Phys. Zeitschr. 4, pp. 619-624, Sept. 1, 1903.)—Discusses the exact limits to be assigned to what is known as Maxwell's theory of electrodynamics as represented by the equations used by Maxwell or the same relations expressed in forms now found more convenient. It is contended that whereas Maxwell's theory was an extension of the previous electro-dynamical theory, so also is the modern theory an extension of Maxwell's. E. H. B.

2986. *Radium Collectors*. H. Beandorf and V. Conrad. (Beibl. Ann. d. Physik, 28, 19, p. 1034, 1904. Boltzmann Festschrift, pp. 691-695, 1904.)—The authors crystallised 0.2 gm. of radium-barium chloride on a copper plate, 10 cm. in diam., and suspended this plate, salt downward, from an insulated pole. This collector differed by up to 15 per cent. from a water-drop collector when joined to a Beandorf recording electrometer [see Abstract No. 578 (1903)]. For comparative measurements such radium collectors could, however, be recommended, especially when exposed to the wind and of large surface. H. B.

2987. *Electric Tides and Earth Currents*. W. H. Sharp. (Elect. Rev. 65, pp. 285-297, Aug. 19, and pp. 357-358, Aug. 26, 1904.)—The author reproduces from the Telegraphic Journal of 1878 the earth-current curves observed on the Peterhead-Egersund cable during the days January 1 to 6, and shows that the curves are distinctly tidal. The year of the observations was not stated in the original, but he finds by referring to the Nautical Almanac that it must have been 1877. He assumes that the earth is surrounded by an electric medium of invariable volume which would become ellipsoidal under the influence of the moon, whose motion would give rise to sinusoidal current waves. In his opinion the aqueous tidal phenomena are secondary to these electric luni-solar tides. H. B.

1988. Cause of the Normal Atmospheric Potential Gradient and of the Negative Charge of the Earth. G. C. Simpson. (Phys. Zeitschr. 5 pp. 325-326, June 15, 1904. From the English.)—According to Ebert, the earth would be impregnated with radio-active emanation, ionising the air in the pores of the soil; when the barometric pressure is reduced, more positive than negative ions are supposed to escape. The author objects that the conditions of the experiments of Ebert and of Zeleny are not fulfilled in nature. The air should pass from a place of high ionisation to one of low ionisation, and at a rate such that not all the ions could be absorbed. This is not so in the soil, and the explanation would not be applicable to the atmosphere above the oceans. To sustain the positive electric potential of the atmosphere would, moreover, require ascending air currents of inadmissible velocities. H. B.

1989. Electrical Dispersion Caused by Various Metals. A. Naccari. (N. Cimento, 8 pp. 28-31, July, 1904.)—A disc of the metal to be examined is insulated under a glass jar and charged to a potential of 110 to 120 volts. The loss of charge in a given time is measured by means of an electroscope. Differences are found in the rate of discharge for different metals. More observations, however, are necessary. S. G. S.

1990. Reversal of Polarity of Influence Machine. J. R. Januszkiewicz. (Phys. Zeitschr. 4 pp. 708-709, Oct. 15, 1903.)—A method of reversing the polarity of a machine while it is in action. R. S. W.

1991. Theory of Ritchie's Experiment. O. Chwolson. (Collection of Physical papers devoted to the memory of T. T. Petrouchewsky, pp. 1-7, 1904.)—Ritchie's apparatus is being applied to a demonstration of Kirchhoff's law in an erroneous way. After pointing out the sources of error, the author develops the accurate theory of the apparatus, and draws attention to some supplementary hypotheses necessary for a demonstration of the law in question by means of this apparatus. A. G.

1992. Kathode Dark Space. G. C. Schmidt. (Ann. d. Physik, 12. 3. pp. 622-632, Sept., 1903. Physik. Instit., Erlangen, July 4, 1903.)—An attempt is here made to work out certain analogies between the discharge in a vacuum tube and the electrolysis of a solution of an inorganic salt. To do this completely the velocities of the ions in the tube are required, but the author has so far been unable to measure these. The number of ions in the dark space is found to be very small as compared with other parts of the tube, and this is due to the greater velocity of the negative ions. Projecting kathode or canal rays into the dark space lowers the kathode fall very greatly, the former more than the latter. R. S. W.

1993. Spluttering of Electrically Heated Metals. G. Aeckerlein. (Ann. d. Physik, 12. 3. pp. 535-557, Sept., 1903. Extract from the Inaugural Dissertation, Physik. Inst. Strassburg.)—From the experiments described here, it seems that there is no connection between the conductivity produced by a hot metal and the metallic dust given off. One may be produced without the other. At high pressures the conductivity possesses a very complicated character. More dust is given off in hydrogen than in air. High temperature alone is insufficient to cause the emission of metallic dust, an electrical field is also necessary. The presence of occluded gas is neither a sufficient nor necessary condition for spluttering to take place. R. S. W.

1994. Absorption of Kathode Rays of Different Velocities. W. Seitz. (Ann. d. Physik, 12. 4. pp. 860-868, Oct., 1903. Physik. Instit. der Univ. Würzburg, July, 1903.)—Curves are given showing the absorption of kathode rays produced by voltages varying from 10,000 to 50,000. The absorption decreases as the voltage is increased. R. S. W.

2995. *Kathode Fall in Helium*. R. Defregger. (Ann. d. Physik, 12. 3. pp. 662-665, Sept., 1903. Physik. Institut. der Univ., Berlin, June, 1903.)—The fall for about ten metals is measured. Copper is the highest with 177 volts, magnesium the lowest with 125. Strutt obtained 226 volts for platinum as against 160 by the author. No explanation of this discrepancy is given. R. S. W.

2996. *Magnetic Deviation of Negative Glow as Function of Magnetic Field Strength*. M. Walter. (Beibl. Ann. d. Physik, 28. 1. pp. 41-42, 1904. Extract from Göttingen Inaugural Dissertation, 1903.)—The distribution in space of the negative glow at various pressures and for unipolar and for uniform magnetic fields is described. [See also Abstract No. 1998 (1904).] S. G. S.

2997. *Potential Fall in Electric Arc*. G. Schulze. (Beibl. Ann. d. Physik, 28. 12. p. 676, 1904. Extract from Hanover Dissertation, 1903.)—The kathode and anode p.d.'s are found to depend on the material of which the electrodes are made in such a way that with higher atomic weight and melting-point these p.d.'s are greater. The author explains this by considering that the current is carried entirely by molecules torn from the electrodes, and that when considerable heat is necessary to liberate these molecules the requisite p.d. is high. S. G. S.

2998. *Kathode Rays and Magneto-Friction*. H. Pellat. (Comptes Rendus, 139. pp. 124-126, July 11, 1904.)—Villard insists that the author [see Abstract No. 2270 (1904)] is dealing with magneto-kathodic rays in his experiments. This Pellat says may be possible, but he claims that he has discovered that ordinary kathode rays experience a force under the action of a magnetic field which is not accounted for by the laws of electromagnetism. R. S. W.

2999. *Studies in Contact Electricity*. I. *The Electric Double Layer and Absolute Potential*. II. *The Production of Electricity by the Movement of Solids in Liquids*. J. Billitzer. (Ann. d. Physik, 11. 5. pp. 902-986 and pp. 987-956, July 7, 1903. II. Physik. Inst., Wien.)—I. Working from Helmholtz's idea of the electric double layer the author investigates the nature and direction of the movements of metal threads suspended in various solutions in a fall of electric potential, also the movements of colloidal metals under similar or identical circumstances. It is then shown how Helmholtz's hypothesis of the double layer must be modified to account for these observations. II. This was fully investigated by measuring the e.m.f. produced by allowing a silver spiral to fall through a vertical column of silver nitrate solution. Changes were made in the strength and temperature of the solution. The spiral was then replaced by more finely divided silver. Other salts were tried instead of silver nitrate. [See Abstracts Nos. 148 and 2688 (1904).] F. S.

3000. *Capillary Electric Movements and a Current in an Open Element*. J. Billitzer. (Ann. d. Physik, 13. 4. pp. 827-835, March, 1904. II Physik. Institut, Wien.)—Since C. Christiansen has recently worked on capillary electric movements [see Abstract No. 616 (1904)] the author has made use of an observation of Palmaer's on the potential difference produced when drops of mercury fall through a liquid [see Abstract No. 2963 (1904)]. It is found that if mercury is allowed to flow in drops into the upper part of a column of water containing an electrolyte a constant current flows between upper and lower portions of the mercury if they are connected by an external circuit. Solutions of potassium chloride with excess of mercurous chloride, mercurous nitrate, and potassium cyanide were used. A full investigation of these phenomena was made, and the author explains Christiansen's results according to his own observations in a previous paper. [See preceding Abstract.] F. S.

3001. Specific Resistance of Rocks. G. de A. d'Ossat. (Accad. Lincei, Atti, 12. pp. 278-284, Oct. 4, 1903.)—The specific resistances of three specimens of rock are determined, a 10 cm. cube being used in each case. The specific resistances are found to be: Travertine 90 megohms, volcanic tufa 2.14 megohms, lava 2.0 megohms. The compositions of the specimens are given. S. G. S.

3002. Production of very High Voltages by Alternating Currents. B. Walter. (Ann. d. Physik, 15. 2. pp. 407-411, Oct. 25, 1904. Physik. Staatslaboratorium, Hamburg, Sept. 1, 1904.)—The author, referring to the use of a special 1,200-volt alternator for producing very high voltages with an induction coil, points out that Koch [see Abstract No. 2729 (1904)] was able to obtain discharges of the same length with an ordinary alternator; and the author disagrees with Wien as to the use of very few turns on the coil, this being wasteful of current. L. H. W.

3003. New Thermoelectric Measuring Instrument. Russner. (Elekt. Rundsch. 21. pp. 324-325, Sept. 15, 1904.)—A portable form of apparatus is described to take the place of mercury thermometers for clinical and other purposes. The e.m.f. of the thermocouple is compared with the drop on a slide-wire potentiometer supplied with a voltage regulable by a current indicator. A diagram of the connections is given. L. H. W.

3004. Kerr Phenomenon. A. Korn and K. Stoeckl. (Ann. d. Physik, 12. 4. pp. 875-888, Oct., 1903.)—A mathematical discussion based on the physical supposition of magnetic particles rotating about their magnetic axis with a very great velocity of rotation proportional to their magnetic moments. [See Abstract No. 1017 (1903).] J. W. P.

3005. Action of Magnetic Field on Continuous Current Arc. E. Martiny. (Deutsch. Phys. Gesell., Verh. 6. 13. pp. 199-208, July 15, 1904.)—The well-known deflection of the arc by a cross-field is here studied quantitatively. The variables are: (1) Distance between carbon ends; (2) necessary fall of potential across the arc; (3) field strength. It is shown that the deflecting influence of field increases suddenly for a certain fall of potential, which itself depends on the distance between carbons. P. E. S.

3006. Magnetic Hysteresis at High Frequencies. C. E. Guye and A. Schidlof. (Archives des Sciences, 18. pp. 410-412, Oct., 1904. Comptes Rendus, 139. pp. 617-619, Sept. 26, 1904.)—The authors have repeated the experiments described in Abstract No. 1456 (1903), from which it was concluded that the power absorbed is independent of the frequency. A bundle of ten fine wires is now used in place of the single wire, and the method has been otherwise improved upon. Within the frequencies used (300-1200 per sec.) the results confirm those previously obtained. L. H. W.

3007. Calibration of Unifilar Magnetometers. P. Schulze. (Ann. d. Physik, 12. 4. pp. 893-895, Oct., 1903.)—Having shown that the deflections and oscillations, both natural in the terrestrial field and artificial, of unifilar magnetometers are asymmetrical [see Abstract No. 109 (1903)], the author gives formulæ for the correct calibration of such instruments, based upon observations of the periods and F. A. Schulze's equations for asymmetrical oscillations. H. B.

3008. Graphic Representation of the Dose Administered in Radiotherapy. A. Bécère. (Archives d'Él. Médicale, 12. pp. 323-329, May 10, 1904.)—The author proposes to keep a record of the amount of rays absorbed in radiotherapeutic treatment, by means of a chart, similar to a fever chart, in which the abscissæ represent the amount of the radiations successively absorbed, and the ordinates the time of treatment. L. H. W.

3009. Influence of the Zinc Ion on the Growth of Hair. **S. Leduc.** (Archives d'Él. Médicale, 11, pp. 585-586, Oct., 1903. Assoc. Franç. pour l'Avancement des Sciences, Congrès d'Angers, Aug. 4-11, 1903.)—By means of electrodes soaked in a 1 per cent. solution of zinc chloride applied to two closely shaven areas on the flanks of a rabbit, a current of 10 milliamps, was passed for 40 minutes through the animal. After a few days the skin desquamated over the area to which the anode had been applied, and subsequently the hair began to grow luxuriantly, much more so than on the remainder of the shaven skin. The introduction under similar conditions of the ions chlorine and potassium did not produce the same result. **H. W. P. Y.**

3010. Arrest of the Heart in Diastole by the Action of Alternating Currents of High Tension. **F. Battelli.** (Archives d'Él. Médicale, 11, pp. 625-627, Oct., 1903.)—The electrodes are placed directly on the wall of the heart, the animal being anesthetised. The following results were obtained: (1) During the passage of an alternating current at 240 volts the heart of the dog is arrested in diastole. (2) At the rupture of the current the ventricles beat afresh if the contact has not been too prolonged. (3) If contact has lasted 10 to 15 secs. the ventricles remain quiescent for a few seconds after rupture and then beat again. (4) Under the same conditions a current at 120 volts provokes the appearance of fibrillary tremors, which persist after the rupture of the current. In this case the heart does not beat again. [See also Abstract No. 1258 (1903).] **H. W. P. Y.**

3011. Nature of Chemical and Electrical Stimulation. **A. P. Mathews.** (Amer. Journ. Physiol. 11, pp. 455-496, 1904.)—From the author's experiments on the nerves of frogs the conclusion is, drawn that the action of a chemical reagent depends on the stability and electrical state of the ion. It appears to be independent of chemical composition except as regards the latter affecting its velocity. Whether a salt stimulates or depresses depends upon the relative predominance of its anion or kation; in the former case, as in hydrates, it stimulates; in the latter it depresses. The chemical composition of the electrode is unimportant compared with its electrical state. **L. H. W.**

3012. Treatment by the Röntgen Rays and by Radium. **R. Morton.** (Archives d'Él. Médicale, 12, pp. 431-433, June 10, 1904. From British Med. Journ. April 23, 1904.)—The various lesions produced by the Röntgen rays are discussed. These rays appear to have a selective action on the sebaceous glands. The obliterative action of the Röntgen rays on the small vessels is of especial use in sarcomata, which are always vascular structures. The uses of radium are the same as those of the Röntgen rays. **H. W. P. Y.**

3013. Treatment of Tinnitus Aurium by the Effluve of High Frequency. **H. Marqués.** (Archives d'Él. Médicale, 12, pp. 492-497, July 10, 1904.)—A brush composed of fine wire connected to the resonator is held opposite the front of the external auditory meatus and martoid process. During the greater part of the séance the distance is sufficient to permit the effluve only, but at the end of each séance a few sparks are given by approaching the electrode. The treatment is most successful in chronic non-purulent otitis, but is useless when otorrhœa is present. In none of the author's cases was there any improvement in hearing obtained. **H. W. P. Y.**

3014. Röntgen-ray Tubes. **d'Arsonval.** (Comptes Rendus, 138, pp. 1142-1145, May 9, 1904.)—Given tubes can be made to act in successive experiments under uniform conditions, by bringing to equality the mean intensity of the currents which traverse them; and by keeping this uniform the working of a tube may be kept constant. The quantity of radiation (photographically effective) per unit of time is proportional to this intensity. **A. D.**

3015. Case of Sarcoma of the Superior Maxilla Cured by Radiotherapy. A. Bécîère. (Archives d'Él. Médicale, 12. pp. 498-508, July 10, 1904.)—The case was of four years' standing. Two operations for removal of the growth had been performed, and the diagnosis confirmed by microscopical examination. Treatment by the Röntgen rays was continued for eight months, at the end of which period the patient was considered to be cured. Injections of bichlorhydrate of quinine were administered throughout the treatment. H. W. P. Y.

3016. New High-power Gaiffe Apparatus. (Archives d'Él. Médicale, 12. pp. 581-581, July 25, 1904.)—This apparatus for Röntgen-ray and high-frequency current production for therapeutic purposes is fully described with numerous illustrations.

3017. Treatment of Neuralgia by the Ion Quinine. S. Leduc. (Archives d'Él. Médicale, 12. pp. 529-580, July 25, 1904.)—A severe case of four years' standing of trigeminal neuralgia in a woman aged sixty-eight years was treated by applying as the positive pole a compress of absorbent wool soaked in 1 per cent. bichlorhydrate of quinine over the painful area and passing a current of 20 milliamps. for 30 min. The first application was followed by marked alleviation, and after a second, three days later, the pain ceased. H. W. P. Y.

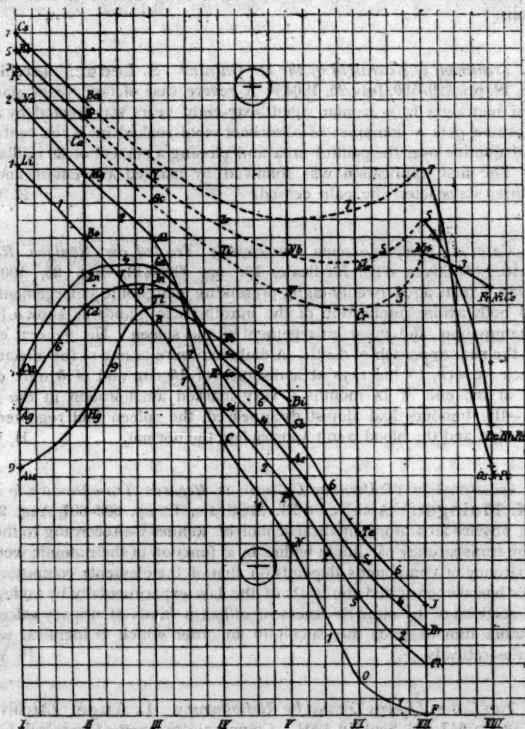
3018. Case of Lymphosarcoma Successfully Treated by Röntgen Rays. J. Bergonié. (Archives d'Él. Médicale, 12. pp. 608-613, Aug. 25, 1904.)—The patient was a man aged twenty-eight, presenting ganglionic enlargements in the neck and both axillæ, implication of the intrathoracic glands as shown by radioscopic examination, and great enlargement of the spleen. His general condition indicated the near approach of death. A daily exposure of one of the affected areas, taking each in turn, to the rays at a distance of 15 cm. and of 5 min. duration, produced at the end of 1½ months a very marked amelioration in the patient's condition—the tumours had almost disappeared, the spleen had regained almost its natural size, and the blood count approached the normal. H. W. P. Y.

3019. Classification of Urinary Calculi as Regards Transparency to Röntgen Rays. M. Maingot. (Archives d'Él. Médicale, 12. pp. 608-607, Aug. 25, 1904. From the physics laboratory, medical school of Rennes.)—According to the law of Benoist the transparency of simple bodies in a function of their atomic weight and the transparency of compounds depends on that of the elements composing them. The author has demonstrated the truth of the law experimentally by taking radiograms of sections of the same thickness of different kinds of urinary calculi. His results enable him to place the calculi in an order which is identical with that obtained theoretically. H. W. P. Y.

3020. Two Cases of Lupus Treated by Radiotherapy. L. Augé. (Archives d'Él. Médicale, 12. pp. 647-654, Sept. 10, 1904. Communication to the Congrès de Grenoble de l'Assoc. Franç. pour l'Avancement des Sciences.)—The first patient presented extensive disease of the lower part of the face, which had spread to both cheeks and had caused considerable destruction of the left external ear. Several surgical operations had been performed without permanent results. Radiotherapy was instituted on December 17, 1903, with tri-weekly séances of 10 min. duration, and was continued with occasional interruptions for four months. A month later the whole of the diseased area had cicatrised with the exception of one small patch, which subsequently healed. The second patient, a girl aged sixteen, had suffered from lupus of the right cheek for thirteen years. At the end of three months' treatment with the Röntgen rays cicatrisation was well established. H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

3021. *Valency and the Periodic System; Attempt to Establish a Theory of Molecular Compounds.* R. Abegg. (Zeitschr. Elektrochem. 9. pp. 575-579, July 9, 1903. Kristiania Videnskabselskabets Skrifter I. Math.-naturw. Klasse, No. 12, 1902. Zeitschr. Anorg. Chem. 39. 3. pp. 380-380, May 10,



GRADATION OF ELECTRO-AFFINITY IN THE PERIODIC SYSTEM.

1904.)—In order to account for a large number of chemical phenomena in a more adequate way than according to the ancient valency theory, the author presumes that though each element possesses a maximum number (8) of existing valencies, the elements need not actuate all their valencies, which are not of the same force. In opposition to previous similar theories, abandoning the hypothesis of a constant valency, the author's theory is in strict agreement with the periodic system of elements, the underlying principle being as follows: "There is no essential difference between such affinities as will give rise to

chemical compounds and those resulting in polymerisation phenomena or molecular compounds between molecules of different kinds." As, however, the former are of a less easy decomposition, affinities of different strength should be postulated, borne out by the fact that compounds of bodies susceptible of several valencies are the more stable as the number of affinities engaged in forming a chemical antipode is less. Chlorine for instance has in FeCl_3 a higher chemical potential than in FeCl_2 ; that is, it is separated from the former with a higher evolution of energy than from the latter. It is further to be supposed that the actuation of the valencies of an element is dependent on the nature of its counterpart, as iodine shows with respect to the positive metals (K, Na, Li, &c.) always a monovalent, and with respect to a negative metalloid a polyvalent (up to 7) behaviour (periodates). Every element, according to the author, possesses both a positive and a negative maximum valency (the sum being always 8), the former corresponding to the number of the group the element belongs to. Whether an element manifests its positive or its negative electro-valency will depend on the polar nature of its fellow-components. The manifestation of one kind of valency seems to counteract to a high degree that of the other, without, however, annihilating it wholly. The author terms *normal valencies*, those present in a smaller number (< 4), which therefore are strongest, while the weaker valencies of opposite polarity and greater number are called the *contra-valencies* of the element. Halogens thus possess 1 negative normal valency and 7 positive contra-valencies, while in an analogous way Ag has 1 positive normal valency and 7 (hypothetical) contra-valencies. The following distribution of valencies in the periodic system is thus obtained:—

Group.	1	2	3	4	5	6	7
Normal valencies	+1	+2	+3	+4	+5	+6	+7
Contra-valencies	-7	-6	-5	-4	-3	-2	-1

Alkali metals are so reluctant to manifest any negative valencies that the positive atoms, not finding any negative counterparts, will form only monatomic molecules. The above ideas about valencies show, especially for the higher groups of the periodic system, the possibility of accounting for the production of molecular compounds by means of their regular variability, so as to do away with any boundary between atomic and molecular affinity. The following considerations on the periodic system are further made: Within each group the difference of the electro-affinity between the main and secondary groups decreases towards the middle of the periodic system, being for instance very high between the alkali metals and Cu, Ag, Au, and smaller between C, Si, Ti, Zr, Ce, Th, and Ge, Sn, Pb. In all the secondary groups the contra-valencies are more developed than in the main groups, thus inclining more to the formation of the complexes. The difference in the electro-affinity and the manifestation of normal or contra-valencies with the main and secondary groups of the eighth group should therefore be expected to be extremely high. The normal valency for this group is equal to ± 0 , the contra-valency ± 8 . In fact this is found in the main group, while the contra-valency is noted in the three triads constituting the secondary group in the case of the system being arranged in a spiral on a cylinder as suggested by Lothar Meyer.

A. G.

3022. *Optical Activity of Asymmetric Nitrogen*. E. Wedekind. (Zeitschr. Phys. Chem. 45. pp. 235-248, Sept. 22, 1903. Chem. Universitätslaborat., Tübingen, April, 1903.)—The author investigates the extent of the analogy

between asymmetric nitrogen and asymmetric carbon. He treats the iodides of suitable quaternary ammonium bases with silver camphor-sulphonate. A less soluble portion is then obtained which has a constant positive rotation. From the mother-liquors a product can be separated with a small, but still positive rotation. He confirms the observations of Pope and others (Chem. Soc., Journ. 77. p. 1127, 1899; and 79. p. 828, 1901) on the optical behaviour of *p*-phenylbenzylallylmethylammonium iodide and *p*-tolylethylallylmethylammonium iodide. He finds that it is difficult to resolve substances of this kind on account of the tendency of the active isomers to auto-racemisation, this being influenced by the relatively easy transition of nitrogen into the trivalent state. Besides, dissociation into optically active ions takes place.

F. S.

3023. *Colours of Iodides*. W. Ackroyd. (Chem. News, 88. p. 217, Oct. 30, 1903. Paper read before the British Association (Section B), at Southport, 1903). The general law of the relation of colour to chemical constitution, given by the author in 1892, states that in related compounds of the general formula, A_xB_y , as B increases in weight (either in atomic mass or multiple of atomic mass) there is increase of absorption of light in definite manner, so that the visible effect is progression in the metachromatic scale from the white towards the black end. Iodides conform to this law; the more heavily weighted molecules have colours near the black end of the scale, while the lighter ones come nearer the white end. In the forty-one examples of iodides in the periodic groups only three are apparently un-conformable, two of these being doubtful exceptions. Where there is more than one iodide of the same metal the law is also obeyed. The same is the case with the halogens, their absorption increasing from fluorine to iodine through the extremes of white to black. Hence, Armstrong's view that colour is an indication of quinonoid structure does not hold for iodides or for inorganic bodies generally.

T. H. P.

3024. *Hypotheses of Valency and the Course of Chemical Reactions*. A. Michael. (Journ. prakt. Chemie, 68. 2. pp. 487-520, 1903.)—The author considers it incorrect to assume that the valency is a measure of the total affinity of the atom, and he regards it as a rough measure of the resultant of the chemical forces acting directly and indirectly in the atom. Further, from various theoretical and practical considerations he arrives at the following laws: (1) In the combination of non-metallic with metallic elements, their total energy is the more completely transformed into combined energy and heat, the more perfect the compensation of the opposite atomic forces. (2) The heat of formation of organic isomerides of the aliphatic series, containing a negative organic nucleus, increases with the total direct and indirect influence of their positive hydrocarbon groups on this nucleus. The hypothesis of partial valencies and a theory of the origin of matter from two primary substances are also discussed.

T. H. P.

3025. *Internal Friction of Alcoholic Solutions*. G. Haffner. (Beibl. Ann. d. Physik, 28. 18. pp. 952-953, 1904. Extract from Dissertation, Erlangen, 1903.)—The author has investigated the internal friction of alcoholic solutions by Poiseuille's method, and the following conclusions are arrived at: (1) The use of curved capillaries is not unassailable even for relative measurements. (2) Tubes of elliptical section give the same results as circular bores. (3) Solutions of salts in aqueous dilute alcoholic solutions behave similarly to

aqueous solutions. (4) Alcoholic solutions near absolute alcohol show a different behaviour, which manifests itself in an increase of friction due to the addition of salts; the formula of Arrhenius ($\eta = A^*$) is inapplicable, though in some cases (CaCl and LiCl) approximately similar values are obtained; with NaI and KI there is a nearly linear relation between concentration and internal friction. With salts of the first group of Sprung (the solutions of which flow quicker at lower temperatures) the effect of the concentration decreases with increasing concentration and temperature. (5) Some experiments of Mühlenbein were repeated, in some case with confirmatory results; some of his results were found to be incorrect. [See also Abstracts Nos. 1828 (1899) and 1829 (1904).] L. H. W.

3026. Budde Effect with Reference to Bromine. B. P. Caldwell. (Amer. Chem. Journ. 31, pp. 61-68, 1904.)—Comparative experiments on the Budde effect in the cases of chlorine and bromine, show that the expansion of the bromine is considerably greater than that of the chlorine; the rise in temperature is insufficient to account for the increase in volume, especially with bromine. The original volume is not resumed immediately, but after an average period of 3 sec. These results lend confirmation to the view of Mellor [see Abstracts Nos. 859 and 408 (1908)] that no evidence exists to show that the action of light on chlorine gas produces any change capable of appreciably affecting its activity towards hydrogen, and indicate also that the same holds for bromine. Mellor's view that the Budde effect is caused entirely by the dissipation as heat of part of the energy absorbed from light requires that the rise of temperature should be much greater with bromine than with chlorine, which is not in accord with the results obtained by the author. T. H. P.

3027. Asymmetric Synthesis. W. Marckwald. (Ber. Deut. Chem. Gesell. 37, pp. 849-854, 1904.)—All previous attempts to synthesise an optically active carbon compound have been based on the combination of an inactive compound, containing either an ethylene linking or a carbonyl group, with an optically active compound to form an ester or glucoside, which is subsequently treated in such a way as to attach two different groups to a previously ethenoid carbon atom, and thus render it asymmetric. The formation of optically acid substances in this manner has not yet been established. The method adopted with success by the author is as follows: Methyleneethylmalonic acid is combined with brucine to form the two acid brucine methylethylmalonates. These have different solubilities, and on heating the brucine salt, crystallised from the mixture of the two, at 170°, and decomposing the portion of the residue soluble in hot water by means of sulphuric acid, a laevo-rotatory valeric acid is obtained. T. H. P.

3028. Chemical Action Produced by Radium. W. Ramsay and W. T. Cooke. (Nature, 70, pp. 841-842, Aug. 11, 1904.)—According to the Rutherford-Soddy hypothesis of the disintegration of the radium atom an enormous amount of energy is evolved, and at least one simpler product, namely helium, is formed. The following experiments appear to indicate that such a change is reversible, that is, that by imparting a sufficient charge of energy to any atom it is transformed into different matter, probably by the building up of a more complex structure. Three bulbs containing 105 m.gm. of radium bromide dissolved in water were connected with a pump and were surrounded with small beakers, one of potash, and the other two of soda

glass. In about six months the former was coloured brown and the latter violet. They were all found to be radio-active, and the radio-activity was removed by washing with water. The solution contains an emanation, for on bubbling air through it and cooling the gas with liquid air the issuing gaseous air is only feebly active; the main part of the activity was retained in the cooled bulb. From the solution which has lost all emanating power further active products are obtainable, some of which are precipitable along with mercurous chloride, some with mercuric sulphide, some with ferric oxide, and some with barium sulphate. There appear to be several radio-active bodies present which can be separated by the ordinary processes of qualitative analysis. The behaviour is different, according as potash or soda glass is employed.

T. H. P.

3029. *Differences in the Reactions of Dextro and Lavo Lactic Acids.* E. Jungfleisch. (Comptes Rendus, 139. pp. 208-206, July 18, 1904.)—The author has in a variety of ways extracted the active *d*- and *l*-lactic acids from the quinine lactates, and prepared a number of salts both of the *d*- and *l*-acids. He finds in general that the active acids exhibit much greater differences in reaction than has hitherto been supposed to exist between optical isomers. Thus the barium lactate formed by the action of excess of baryta for an hour on the *d*-quinine lactate gave a rotation $\alpha_D = -0^\circ.88$, while that furnished under the same conditions by *l*-quinine lactate gave $\alpha_D = 0^\circ$. Similar differences were observed when potash or lime was made to act on the two active quinine lactates.

D. H. J.

3030. *Natural Chemical Rule.* A. Jaques. (Chem. News, 90. p. 107, Aug. 26, 1904.)—The salts of many metals form compounds with ammonia, and in some cases it appears that the metal is absorbed into the ammonium radicle, while in others it is more probable that the combination is purely intermolecular, i.e., that the salt combines directly in some way with ammonia without any direct atomic action between the metal and the nitrogen. Further, a large number of other metals form compounds in which they function as acid-forming elements, another metal appearing as the base. The author finds that, in general, no metal forms compounds belonging to these two classes. From the list given it appears that only two metals, viz., zinc and gold, are exceptions to this rule, that is, these two metals form both compounds with ammonia and compounds in which they function as negative elements.

T. H. P.

3031. *Artificial Manufacture of Ruby.* A. Verneuil. (Annal. Chim. Phys. 3. pp. 20-48, Sept., 1904.)—The fusibility of Al_2O_3 has been known since the invention of the oxyhydrogen blowpipe, but A. Gaudin was the first to make experiments (1837-1869) on the artificial production of transparent Al_2O_3 , and finally concluded that it was not possible to produce stones on account of the excessive tendency of the product to devitrify. This conclusion was verified by Sainte-Claire Deville. The problem under this form appeared insoluble until C. Friedel produced artificial rubies. The author now re-examines the conditions necessary to obtain alumina in a transparent state. He decides that it is necessary to use a flame rich in H and C and has designed a special vertical blowpipe, which he describes. The substance fused consisted of precipitated alumina containing 2.5 per cent. of chromium oxide. The properties of the artificial rubies are identical with the natural variety.

This applies to the general physical properties such as luminescence, hardness, colour, and crystal form, so that a true ruby synthesis has been accomplished, but in the present state of the research the products obtained can be distinguished by experts from the natural ruby. W. W. H. G.

3032. *Gas-absorption by Charcoal and Coke.* G. Craig. (Chem. News, 90. p. 109, Sept. 2, 1904.)—The author has carried out an investigation relating to the gases occluded by lignite coke, and has found that in every case the oxygen disappears and is converted into water by union within the pores of the coke with hydrogen. That this disappearance is not due to slow combustion of, or to union with the carbon, is proved by the absence of CO_2 in the occluded gases. The author therefore suggests that lignite coke must present a hydrogen surface to the air which passes into its pores, and that in a galvanic couple it would act as a positive element to an ordinary battery carbon. Actual experiment proved this surmise correct. Some remarks upon the bearing of these observations upon Dewar's researches—with charcoal absorption at liquid-air temperatures—are made in conclusion [see Abstract No. 2919 (1904)]. J. B. C. K.

3033. *Thorium; Carolinium, Berzelium.* C. Baskerville. (Chem. News, 90. pp. 151–153, Sept. 23, and pp. 163–166, Sept. 30, 1904. Paper read before the Amer. Chemical Society, April 8, 1904.)—The author gives a short historical account of the discovery of thorium and the questions raised as to its elementary character. Experiment shows that thorium is not a primary radio-active body. Its complex nature is proved by the behaviour of its salts towards certain organic bases, for example, phenylhydrazine; from material having the atomic weight 232.5, fractions were obtained having atomic weights varying from 212 to 252. The action of a current of chlorine on pure thorium oxide mixed with pure sugar carbon and heated in a quartz tube yields: (1) A volatile chloride (the "weisser Dampf" of Berzelius) decreasing in amount as the duration and temperature of the reaction are raised; the purified, pale green oxide obtained from this chloride has the specific gravity 8.47 and the corresponding metal, known as berzelium, the atomic weight 212 (tetravalent). (2) Thorium tetrachloride, distilled off on raising the temperature; thorium, purified in this way to a great extent from berzelium and carolinium, has the atomic weight 220.6 and forms a white oxide of specific gravity 9.2. The original thorium had the atomic weight 232.5–232.6, the specific gravity of its oxide being 10.5. (3) A residue which, on purification, gives a greyish-pink oxide of specific gravity 11.26; the corresponding metal—carolinium—has the atomic weight 255.6 (tetravalent). The original thorium dioxide phosphoresces under the influence of ultra-violet light, whilst berzelium and carolinium oxides do not. The new thorium glows with a luminosity increasing as the amounts of berzelium and carolinium oxides decrease. All these bodies are radio-active. Certain chemical differences are found in the behaviour of these metals. T. H. P.

3034. *Influence of Salts on the Solubility in Water of Hydrogen Sulphide, Iodine, and Bromine.* W. H. McLaughlan. (Zeitschr. Phys. Chem. 44. pp. 600–633, Aug. 4, 1908. Phys. Chem. Abth. des Chem. Universitätslaboratoriums, Breslau.)—The vapour pressure of hydrogen sulphide from aqueous salt solutions was determined by the dynamical method. Direct solubility measurements showed a good agreement with Henry's law. Similar measure-

ments were made on the solubility of iodine and bromine. The following table summarises the results that have been obtained on the lowering of solubility by different salts, and shows a very marked parallelism except in the case of ammonia and sulphur dioxide :—

	H ₂ S 25°	NH ₃ 25°	Phenyl Thiocarbamide. 25°	I 25°	CO ₂	H ₂	Ethyl Acetate.	N ₂ O	SO ₂ 25°	Br 25°
Na ₂ SO ₄	0.37	0.31	0.41	0.355	0.32	0.37	0.43	0.30	0.043	0.29
K ₂ SO ₄	0.22	0.23	0.37	0.15	—	—	—	—	—	0.27
(NH ₄) ₂ SO ₄	0.18	0.17	0.28	0.19	—	—	—	—	—	—
NaCl.....	0.153	0.11	0.28	—	0.21	0.21	0.34	0.24	—	—
KCl.....	0.147	0.134	0.24	—	—	0.20	—	0.23	—	—
NaNO ₃	0.107	0.10	0.10	0.115	0.10	0.20	—	—	—	0.18
KNO ₃	0.087	0.14	0.08	0.05	0.09	0.19	—	—	—	0.15
NaBr.....	0.065	0.08	—	—	—	—	—	—	—	—
KBr.....	0.035	0.096	0.15	—	—	—	—	—	—	—
NH ₄ Cl.....	0.04	0.03	—	—	—	—	—	—	—	—
KI.....	0.03	0.05	—	—	—	—	—	—	—	—
NH ₄ NO ₃	0.01	—	—	0.03	—	—	—	—	—	—
NH ₄ Br.....	—	—	—	—	—	—	—	—	—	—
NH ₄ Ac.....	—	—	—	—	—	—	—	—	—	—
KAc.....	—	0.23	—	—	—	—	—	—	—	—

T. M. L.

3035. *Setting and Swelling of Gelatine.* P. v. Schroeder. (Zeitschr. Phys. Chem. 45, pp. 75–117, Sept. 1, 1908.)—The viscosity, measured at 25°, of a gelatine solution heated at 100°, gradually diminishes to a constant minimum; this change is attributed to a hydrolytic process which follows a logarithmic law. Further, if after heating at 100°, the gelatine solution is kept at 25°, its viscosity increases at a rate closely related to the ability of the solution to set. With the exception only of potassium and ammonium nitrates, all the sulphates, nitrates, and chlorides of sodium, potassium, and ammonium, as well as the chlorides and sulphates of lithium and magnesium, increase the viscosity of gelatine solutions, the greatest effect being produced by magnesium salts. The order of the ions with respect to their influence on the viscosity is the same for gelatine solutions as for water. The process of hydrolysis referred to above is accelerated by both hydrogen (hydrochloric acid) and hydroxyl ions (sodium hydroxide), the final values of the viscosity then arrived at being lower than that reached in pure or salt-containing gelatine solutions. The author shows that the vapour pressure of gelatine after soaking in water is greater than that of water at the same temperature.

T. H. P.

3036. *Certain Regularities in the Molecular Volumes of Inorganic Salts in Aqueous Solutions.* C. Forch. (Ann. d. Physik, 12. 3. pp. 591–601, Sept., 1908. Physik. Institut der techn. Hochschule, Darmstadt.)—The author attempts in the present communication to calculate the separate volume changes of solute and solvent for a series of salt solutions, using the density determinations as found in the literature. If in 1 litre of solution of density s there are m_s gm.-mol. of salt dissolved, and if A_s is the molecular weight of the salt, then the number of gm.-mol., m_w of solvent in 1 litre of solution is $m_w = \frac{s - m_s A_s}{A_w}$, where A_w is the molecular weight of the solvent. If ϕ_s and ϕ_w are the molecular volumes of the salt and solvent in the state of solution, then $m_s \phi_s + m_w \phi_w = 1,000$, on the supposition that both remain as independent individuals in the solution. The molecular volumes are also a function of the concentration. In the case of non-electrolytes like sugar, the value of ϕ_s scarcely changes with concentration, and is not greatly different from that of the solid; in the case of a comparatively poor conductor like H₃PO₄,

the value of ϕ , begins to diminish only at fairly great dilution; in the case of good conductors, this diminution is observed even in fairly concentrated solutions. The author shows, however, that ionisation is not the determining factor. The author gives the following table of the molecular volume contraction of salts on passing into a solution containing 1 gm.-mol. per litre:—

	F.	Cl.	Br.	I.	NO ₃	ClO ₃	BrO ₃	OH.	$\frac{1}{2}$ CO ₃	$\frac{1}{2}$ SO ₄
H	—	—	—	—	—	—	—	—	—	9.3
NH ₄	—	-2.8	—	3.3	-1.3	—	—	—	—	7.1
Li	—	1.8	—	?	—	—	—	—	—	—
Na	—	8.0	—	5.2	7.2	8.4	7.0	>19	18.7	14.3
K.....	10.9	7.7	6.9	7.2	7.0	—	—	18.1	24.2	10.7
Ag	—	—	—	—	8.3	—	—	—	—	—
$\frac{1}{2}$ Ca	—	14.0	—	—	13.3	—	—	—	—	—
$\frac{1}{2}$ Sr	—	14.6	11.6	11.8	11.4	—	—	—	—	—
$\frac{1}{2}$ Ba.....	—	12.4	9.4	—	12.5	—	—	—	—	—
$\frac{1}{2}$ Mg	—	12.6	—	—	?	—	—	—	—	19.2
$\frac{1}{2}$ Zn.....	—	12.2	11.0	—	—	—	—	—	—	20.1
$\frac{1}{2}$ Cd	—	12.1	5.5	-1.0	?	—	—	—	—	14.2
$\frac{1}{2}$ Cu.....	—	—	—	—	—	—	—	—	—	19.3
$\frac{1}{2}$ Mn	—	18.5	—	—	—	—	—	—	—	16.6
$\frac{1}{2}$ Fe.....	—	—	—	—	—	—	—	—	—	18.9
$\frac{1}{2}$ Ni.....	—	—	—	—	—	—	—	—	—	17.5
$\frac{1}{2}$ Pb	—	—	—	—	12.8	—	—	—	—	—
$\frac{1}{2}$ Ce.....	—	—	—	—	—	—	—	—	—	18.3

Hence for the concentration of 1 gm.-equivalent per litre, the molecular volume contraction for three monovalent elements combined with a monovalent radical, is 7.6 ± 0.95 ; for a series of divalent elements combined with monovalent radicals 12.4 ± 0.96 ; and for divalent elements combined with SO₄, 18.6 ± 0.98 . Certain exceptions are pointed out, and it is noted that the material must be considerably extended yet before a decision as to the true nature of the regularities can be arrived at. [See also Abstract No. 1078 (1902).] A. F.

3037. *Kinetics of Reduction Processes.* H. Goldschmidt. (Zeitschr. Elektrochem. 9. pp. 725-726; Discussion, pp. 726-727, Sept. 3, 1908. Paper read before the 10 Hauptversammlung. d. Deut. Bunsen Gesell. (Section 10), June 3-8, 1908, at Berlin.)—The rate of reduction of nitro-bodies by hydrogen sulphide in presence of hydrosulphides is proportional to the concentrations of the nitro-compound and of the SH'-ions, but is independent of that of the hydrogen sulphide. The first product of the reduction is a hydroxylamine derivative, the amine only being formed when the concentration is so small that the solution becomes strongly alkaline. The reduction of nitro-compounds by stannous chloride and hydrochloric acid proceeds proportionally to the first powers of the concentrations of the nitro-body, the stannous chloride, and the hydrochloric acid; this would be best explained by supposing that the reduction is effected by the complex molecules HSnCl₃. When stannous bromide and hydrobromic acid are used in place of the corresponding chloro-compounds, the reaction is of the same type, but the velocity is about $7\frac{1}{2}$ times as great; this shows that the stannous ions do not constitute the reducing agent, because they are present to the same extent in the chloride solution as in that of the bromide. The reduction of

nitro-compounds by means of stannous salts, like the electrolytic reduction, yields first a nitroso-compound, which then undergoes further reduction with infinite velocity. [See also Abstract No. 2786 (1904).] T. H. P.

3038. *Action of a Trace of Water on the Decomposition of Alkali Hydrides by Acetylene.* H. Moissan. (Comptes Rendus, 187. pp. 463-466, Sept. 14, 1908.)—It is well known that perfectly dry carbon dioxide does not act on alkali hydrides at the ordinary temperature, whilst the presence of a trace of water-vapour causes the immediate formation of a formate. In the same way, acetylene dried by contact with fused potassium hydroxide does not react with the alkali hydrides at ordinary temperatures; the reaction, $2KH + C_2H_2 = C_2K_2 + H_2$, takes place under these conditions only at a temperature of 42° , the mass glowing and depositing carbon. If, however, the acetylene contains a trace of water-vapour, the conditions of the reaction are so changed that it takes place at the ordinary temperature. This behaviour is attributed to the disengagement of heat which, when it begins at one point, determines a rise of temperature of the hydride to 42° , so that the change becomes complete. T. H. P.

3039. *Equilibrium between Sulphur Trioxide, Sulphur Dioxide, and Oxygen.* G. Bodländer and K. Köppen. (Zeitschr. Elektrochem. 9. pp. 787-794, Sept. 24, 1908.)—The following values are obtained for the equilibrium constant $K = C_1^2 C_2 / C_3$, for mixtures of sulphur dioxide (C_1), oxygen (C_2), and sulphur trioxide (C_3) in presence of platinum gauze at various temperatures: 515° , $K = 8.61 \times 10^{-6}$; 558° , $K = 1.61 \times 10^{-5}$; 610° , $K = 1.19 \times 10^{-4}$; and 650° , $K = 5.80 \times 10^{-4}$. From the numbers obtained with a mixture of equivalent quantities of sulphur dioxide and oxygen, and also in presence of nitrogen and of excess of oxygen, the heat of formation of sulphur trioxide is calculated to be 25,500 cal. The application of the results obtained to the contact-process of sulphuric acid manufacture is discussed. [See also Abstract No. 2061 (1904).] T. H. P.

3040. *Theory of Silicate-Flux Solutions.* J. H. L. Vogt. (Zeitschr. Elektrochem. 9. pp. 852-856, Oct. 22, 1908. Report read before the 5 International Congress für angewandte Chemie.)—The paper deals with the application of the physico-chemical theory of solutions to silicate fluxes, including eruptive rocks. By chemical and microscopical investigation of slags, &c., and extensive synthetic experiments, the author has determined the conditions for the formation of minerals in silicate fluxes containing Ca, Mg, Fe, Mn, and in those containing Ca— Al_2O_3 . The minerals chiefly concerned are the ortho-silicates (R_2SiO_4) of the Olivine and Willemit series, metasilicates of several series, viz., the Pyroxenes, Enstatine-Hypersthene, Augite, Wollastonite, Rhodonite, and also new artificial species of the molecular form $RSiO_3$, in which R may be Ca, Ba, Sr, Zn, Pb (hexagonal), and Mg, Fe (monoclinic or triclinic), and further the minerals of the Melilite series, Anorthite, Spinell, Magnetite, &c. The depression of the freezing-points of mixed silicate fluxes has been carefully determined by the author, partly by direct measurement and partly by calculation from Ackermann's accurate determinations of the total heat. The specific heat of the silicate minerals increases rapidly with rise of temperature, and at $1,100^\circ$ C. is nearly double that at 0° C. The latent heat of fusion of these minerals is about 1/5th of the total (absolute) heat of fusion. The main result of the investigations is that the limit of individual

crystallisation coincides with the greatest depression of freezing-point, at all events in the case of a binary system, and that therefore the "limit of individual crystallisation" is identical with the "eutectic mixture" of the two components. The freezing-point depressions, measured on six series, amounted to from 200° to 400° C., so that pyrometric errors amounting even to 50° C. could not affect the result. On comparing the observed depression of the freezing-point with that calculated by van't Hoff's formula, excellent agreement is obtained, on the assumption that electrolytic dissociation is negligible, and using the least possible value of the molecular weight of each mineral. It follows that silicate fluxes are really mutual solutions of chemical compounds, and that these compounds are those which crystallise from the flux on cooling. On this view, glass is an under-cooled solid solution, in which the freezing-point has been very much lowered, probably down to 750° or 800° C.; at this low temperature, however, the viscosity of the solution is so great that crystallisation can only occur with extreme slowness. Petrographic characters may also be explained on the basis of the theory of solutions; thus Rosenbusch's rule for the order of crystallisation is found to be fallacious, while the observation of Teall as to the analogy of some granites with the eutectic structure typical of alloys, is confirmed. Attention is also drawn to the part played by the phenomena of undercooling in rock crystallisation.

3041. *Ammonia and Metallo-ammonium Bases*. I. H. Euler. (Arkiv Kem. Min. Geol. 1. No. 1. pp. 77-91, 1908.)—None of the hypotheses put forward in explanation of the transformation of tervalent into quinquevalent nitrogen—including those of Werner [see Abstract No. 127 (1902)], Hantzsch, who introduces the idea of the hydration of the ions, Spiegel, who brings forward the notion of "neutral affinities" produced by electrons, and Hinrichsen, is capable of treating this change in a quantitative manner. According to the author's views, which are based on the ionic hypothesis and the law of mass action, the equilibrium between ammonia and ammonium hydroxide in aqueous solution is expressed by the equation $k = K_{\text{water}}/(K_2 \cdot K_3)$, in which the constants K_2 and K_3 are determined by $C_{\text{NH}_4}^+ \cdot C_{\text{OH}}^- = K_2 \cdot C_{\text{NH}_4\text{OH}}$ and $C_{\text{NH}_3} \cdot C_{\text{H}}^+ = K_3 \cdot C_{\text{NH}_4}^+$. In this it is assumed that an atom of nitrogen can take up both positive and negative charges; but if the valency is considered as the action of electric charges, this is merely an expression of the fact that four positive atoms and one negative atom give, with one atom of nitrogen, a stable compound. The above method of regarding change of valency may also be applied to the change of a double linking between carbon atoms into a single one, to the change of the degree of oxidation of a compound; for example, the conversion of cuprous into cupric oxide, &c. The following law, based on the above principles, is laid down by the author: The compositions of all chemical compounds and molecular compounds must be regarded as a function of a force of valency (probably of an electrical nature), and also, as was done by van't Hoff, of the temperature and pressure (also of the solvent). In other words: The change of valency is due to the simultaneous splitting off of two oppositely charged ions in such quantities that their maximum dissociation product is exceeded. The author then gives the results of conductivity measurements of solutions of various bases in ammonia and in amines. The numbers obtained for silver oxide have already been given. The new values arrived at are for zinc hydroxide in ammonia, cadmium hydroxide in ammonia, aluminium hydroxide in methylamine, and

magnesium hydroxide in ammonia and methylamine. Concentration elements containing (1) ammoniacal and aqueous zinc sulphate solutions and (2) ammoniacal and aqueous cadmium sulphate solutions were also examined.

T. H. P.

3042. *Influence of Kathions on the Coagulability of the Blood.* G. Buglia. (Accad. Sci. Torino, Atti, 39, 14a. pp. 678-708, 1903-1904.)—Of a large number of salts examined by the author, all except two—mercuric chloride and silver nitrate—are capable of rendering blood non-coagulable. The proportions of the various salts required to effect this change vary very considerably, and the intensity of the anti-coagulating action is closely related to the chemical nature of the metal (kathion) of the salt; the most active salts in this respect are those of the heavy metals, less active are those of the alkaline-earth metals, whilst salts of the alkali metals are only very slightly active. Further, with most but not all salts, it is possible to restore the power of coagulating to the blood by various means. Salts are hence divisible into two groups: (1) This comprises those which only prevent blood from coagulating when in moderately large doses, which produce no profound change in the physical aspect of the blood, and which can have their action annulled by the addition either of physiological or chemical solutions or of serum. (2) In this group are those salts which in very small doses prevent the coagulation, which produce in the blood changes visible macroscopically (formation of white floccules), and the action of which is destroyed neither by dilution nor by precipitants nor by the addition of serum. There is a certain minimum or critical molecular concentration for each salt which must be attained or exceeded in order that blood may be prevented from coagulating. The determination of the anti-coagulating power of a salt rests, in some cases, very largely with the kathion, and only to a slight extent with the anion, whilst in other cases the reverse holds. Most active are the anions and kathions C_2O_4 , PO_4 , P_2O_7 , $C_6H_5O_7$, Cd, Zn, Co, Ni, Fe, and Pb; whilst only slightly active are Cl, NO_3 , CH_3CO_2 , Na, Li, K, Rb, and Cs, so that a salt like NaCl will have an extremely slight action.

T. H. P.

3043. *Adsorption Compound of Iodine with Basic Lanthanum Acetate.* W. Biltz. (Ber. Deut. Chem. Gesell. 37. pp. 719-724, 1904.)—The amount of iodine removed from its solution in potassium iodide by known quantities of the gelatinous precipitate formed by adding ammonia to lanthanum acetate solution varies largely with the physical state of the precipitate, but approximately the same proportion of the total amount of iodine is withdrawn by a fixed quantity of the same precipitate from solutions containing varying amounts of iodine. These results are similar to those obtained by Küster in the case of iodine and starch. This analogy with starch is rendered complete by the fact that a colloidal solution of basic lanthanum acetate, obtained by dialysis, absorbs iodine according to the same law.

T. H. P.

3044. *Catalysis of Hydrazine.* A. Purgotti and L. Zanichelli. (Gazzetta Chim. Ital. 34. 1. pp. 57-57, 1904.)—The authors confirm the accuracy of the equation, $8N_2H_4 = 4NH_3 + N_2$, given by Tanatar [see Abstracts Nos. 1911 (1902) and 189 (1903)] for the catalysis of hydrazine by platinum black. From the behaviour of platinum after treatment in various ways it is considered that the catalysis of hydrazine is initiated by traces of oxygen occluded by the platinum. Contrary to the view expressed by Tanatar (*loc.*

cit.), the authors are of opinion that the mechanism of the catalysis of hydrazine is totally different from that of the catalysis of hydroxylamine. A study of the catalysis of aqueous solutions of hydrazine sulphate indicates that the velocity of decomposition increases nearly proportionately to the increase in the amount of platinum used, and roughly proportionately to the increase of concentration of the hydrazine salt. The velocity of decomposition of hydrazine salts by platinum varies considerably with the acid of the salt, being greatest for the monohydrochloride and least for the dihydrobromide. Traces of hydrofluoric, hydrobromic, hydriodic, and nearly all organic acids, greatly retard if they do not inhibit the catalysis.

T. H. P.

3045. Stibine and Yellow Antimony. A. Stock and O. Guttmann. (Ber. Deut. Chem. Gesell. 87. pp. 885-900, 1904.)—The authors describe the preparation and properties of antimony hydride. The gas is relatively stable in the dry state, but when decomposition has begun the antimony deposited rapidly accelerates the change. Light and radium emanations do not influence the velocity of decomposition, but moisture has a very great accelerating effect; ammonia or hydrogen chloride also hastens the decomposition. In the liquid condition antimony hydride is unstable at ordinary temperatures. A yellow modification of antimony is obtained by passing a current of air or oxygen into the liquefied hydride at -90° . This yellow antimony is very unstable, and even at -50° rapidly changes into the ordinary form.

T. H. P.

3046. Decomposition of Antimony Hydride as an Example of a Heterogeneous Catalytic Reaction. A. Stock and O. Guttmann. (Ber. Deut. Chem. Gesell. 87. pp. 901-915, 1904.)—The curve representing the relation between the proportion of gaseous antimony hydride decomposed and the time varies greatly with the nature of the surface of the containing vessel. A clean, smooth glass surface yields an S-shaped curve, one etched with hydrofluoric acid gives a curve slightly S-shaped, while one coated with antimony yields a hyperbolic curve. The deposited antimony greatly accelerates the decomposition of antimony hydride at first, but after a time very largely loses the power to do so. The effect obtained with antimony-coated surfaces varies according as the deposition of metal is carried out at ordinary or at higher temperatures, and this is found to be due to differences in the crystalline form of the deposit. The decomposition is not in accord with van't Hoff's equation, but agrees moderately well with the expression—

$$V = 2(x_1 - x_2)/(x_1 + x_2)(t_2 - t_1),$$

where V is the proportion of hydride decomposed in unit time (1 hour), calculated on the mean of the amounts present at the beginning and end of the time. Allowance has to be made in the calculations for the fact that antimony hydride deviates appreciably from Boyle's law on account of molecular attraction. The author considers it probable that the action is instantaneous at the surface of the antimony, and that what is measured is the diffusion. [Compare Abstract No. 988 (1904).]

T. H. P.

3047. Catalytic Decomposition of Antimony Hydride. M. Bodenstein. (Ber. Deut. Chem. Gesell. 87. pp. 1861-1868, 1904.)—The decomposition of antimony hydride into hydrogen and antimony, the latter product accele-

rating the change, is an instance of "autocatalysis." The author's results confirm those obtained by Stock and Guttman [see preceding Abstract]. The catalytic action of the antimony is found to be proportional to its mass, but this is in accord with surface action if the antimony is deposited as small particles. It cannot be decided whether what is measured is the velocity of reaction or that of diffusion. Light on this question would be obtained by the determination of the temperature coefficient. T. H. P.

3048. *Nature of Concentrated Solutions of Electrolytes. Hydrates in Solution.* H. C. Jones and F. H. Getman. (Amer. Chem. Journ. 81. pp. 808-859, 1904. Chem. News, 89. pp. 157-158, March 81, 1904.)—Results are given of measurements of the freezing-points, conductivity, and refractivity of solutions of the chlorides, sulphates, and nitrates of manganese, nickel, cobalt, copper, and aluminium. In all cases, except that of aluminium sulphate, a minimum value is exhibited in the molecular depression of the freezing-point, but no sign of a minimum is found in the conductivity and refractivity curves. Determinations of the molecular elevation of boiling-point produced by the iodides of potassium, sodium, cadmium, and ammonium, and by sodium bromide show that, with the exception of the last-named, all these salts exhibit a well-defined minimum in the molecular elevation, but this occurs at greater concentrations than in the corresponding freezing-point curves. The results obtained afford confirmation of the view that in concentrated solutions the dissolved substance combines with the solvent with the formation of hydrates, which exist in the solution together with a small proportion of ions resulting from the electrolytic dissociation of the salt, and that those substances which yield crystals containing the largest amount of water of crystallisation would be expected to form the most complex hydrates in solution. The composition of the hydrates is calculated in those cases in which sufficient data are obtained, and it is found that the hydrates decrease regularly in complexity with the dilution, and disappear entirely at a dilution greater than that at which the freezing-point minimum occurs. [See also Abstract No. 1090 (1904).] T. H. P.

3049. *Oceanic Salt Deposits. 84. Maximal Tension of Constant Solutions at 88°.* J. H. van't Hoff, U. Grassi, and R. B. Denison. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 14. pp. 518-521, March 10, 1904.)—The following table shows the vapour pressure at 88° C. of solutions saturated with common salt and one, two, or three other salts:—

Saturated with Sodium Chloride and	Pressure in mm. of Mercury reduced to 0°.	Saturated with Sodium Chloride and	Pressure in mm. of Mercury reduced to 0°
O.	988.3	K. Loewite, kieserite	965.8
A. MgCl ₂ , 6H ₂ O	106.2	L. MgCl ₂ , 6H ₂ O, kieserite	104.7
B. KCl	973.9	Z. MgCl ₂ , 6H ₂ O, kieserite, carnallite	101.9
C. Na ₂ SO ₄	997	Q. KCl, kieserite, carnallite	188.6
D. MgCl ₂ , 6H ₂ O, carnallite	108.4	R. KCl, kieserite, langbeinite	315.7
E. KCl, carnallite	185.8	Y. Kieserite, langbeinite, loewite	955.2
F. KCl, glaserite	971.3	W. Glaserite, langbeinite, loewite	969.5
G. Na ₂ SO ₄ , glaserite	983.3	P. KCl, glaserite, langbeinite	965
H. Na ₂ SO ₄ , vanthoffite	991.7	V. Glaserite, loewite, vanthoffite	975.5
I. Loewite, vanthoffite	983.9	S. Na ₂ SO ₄ , glaserite, vanthoffite	979

T. M. L.

3050. *Oceanic Salt Deposits. 85. Composition of the Constant Solutions at 88°.* J. H. van't Hoff, H. Sachs, and O. Biach. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 18. pp. 576-586, March 24, 1904.)—The following table

shows the composition of solutions saturated at 88° with sodium chloride and one, two, or three other salts. A graphical representation is also given.

Saturated with Sodium Chloride and	Per 1,000 Mols. H ₂ O in Molecules.				
	Na ₂ Cl ₂	K ₂ Cl ₂	MgCl ₂	MgSO ₄	Na ₂ SO ₄
O.	59	—	—	—	—
A. MgCl ₂ . 6H ₂ O	1	—	121	—	—
B. KCl	39	37	—	—	—
C. Na ₂ SO ₄	56.5	—	—	—	8
D. MgCl ₂ . 6H ₂ O, carnallite	1	2	117	—	—
E. KCl, carnallite	1.5	10	92	—	—
F. KCl, glaserite	39.5	39	—	—	4.5
G. Na ₂ SO ₄ , glaserite	48.5	21	—	—	11.5
H. Na ₂ SO ₄ , vanthoffite	51	—	4.5	10.5	—
I. Vanthoffite, loeweite	35	—	22	12.5	—
K. Loeweite, kieserite	12.5	—	61.5	5.5	—
L. Kieserite, MgCl ₂ . 6H ₂ O	1	—	120	1	—
P. KCl, glaserite, langbeinite	29.5	33.5	13	10	—
Q. KCl, carnallite, kieserite	2	12	86.5	5	—
R. KCl, langbeinite, kieserite	11	16	76	5	—
S. Glaserite, Na ₂ SO ₄ , vanthoffite ...	43	22.5	—	7.5	5.5
V. Loeweite, glaserite, vanthoffite ...	34.5	28.5	8.5	17.5	—
W. Loeweite, glaserite, langbeinite...	30	24.5	12	16.5	—
Y. Loeweite, kieserite, langbeinite...	16	10.5	42	14	—
Z. Carnallite, MgCl ₂ . 6H ₂ O, kieserite	1	2	116	1	—

T. M. L.

3051. *Oceanic Salt Deposits*. 36. *The Mineral Combinations (Parageneses) from 25° to 88°*. J. H. van't Hoff and W. Meyerhoffer. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 20, pp. 659-670, April 14, 1904.)—Tables have already been given to show the character of the minerals that can coexist in contact with solutions of the chlorides and sulphates of sodium, potassium, and magnesium at 25° and at 88°. In the present paper the various changes which take place between 25° and 88° are described, and the temperatures at which they take place have been determined. Thus schönite changes by loss of water into leonite at 26° in presence of salt, astrakanite, and glaserite, $K_2Mg(SO_4)_2 \cdot 6H_2O \rightleftharpoons K_2Mg(SO_4)_2 \cdot 4H_2O + 2H_2O$, and therefore at about 25.6° the combination or paragenesis of schönite and potassium chloride disappears. This is expressed by the following scheme:—

25°.			25.6°.			96°.		
MgCl ₂			MgCl ₂			MgCl ₂		
Kies.		Carn.	Kies.		Carn.	Kies.		Carn.
Mg 6	Kain.	ClK	Mg 6	Kain.	ClK	Mg 6	Kain.	ClK
Mg 7	Leon.		Mg 7	Leon.		Mg 7	Leon.	
Astr.	Sch.		Astr.	Sn.		Astr.	Leon.	
Then.	Glas.		Then.	Glas.		Then.	Glas.	

In a similar way, reichardite, $MgSO_4 \cdot 7H_2O$, in presence of sodium chloride and astrakanite, becomes unstable above about 27.5°, and the paragenesis of

reichardite and astrakanite gives place to one of the hexahydrate $\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$, with astrakanite. Above 85.5° the hexahydrate in its turn disappears, and the coexistent minerals are then astrakanite and kieserite, $\text{MgSO}_4 \cdot \text{H}_2\text{O}$. The interval between 87° and 55° sees the appearance of langbeinite, $\text{K}_2\text{Mg}_2(\text{SO}_4)_6$, from leonite and kieserite at about 87° , its disappearance at about 87.5° , and the formation of loeweite at 48° and vanthoffite at 46° . Finally, the third period between 55° and 88° sees the disappearance of astrakanite, leonite, and kainite.

T. M. L.

3052. *Oceanic Salt Deposits. 37. Potassium Pentacalcium Sulphate and a Double-Salt related to Kaliborite. J. H. van't Hoff* [with Geiger and Lichtenstein.] (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 28. pp. 985-987, June 2, 1904.)—I. The compound $\text{K}_2\text{Ca}_5(\text{SO}_4)_8 \cdot \text{H}_2\text{O}$, is formed by digesting precipitated gypsum at 100° with 5 per cent. potassium sulphate solution. The following table shows the concentration as regards potassium sulphate, of solutions saturated at 88° with the following salts:—

	Mols. K_2SO_4 per 1,000 H_2O .
1. Potassium sulphate	23.1
2. Potassium and syngenite.....	22.6
3. Syngenite and pentasalt	9.9
4. Pentasalt and anhydrite	1.8

The concentration of calcium sulphate in the solution is always small, and was not determined. The most favourable concentration for the formation of the pentasalt is intermediate between 3 and 4, with about 5 per cent K_2SO_4 . II. The double-salt has the composition $2\text{K}_2\text{O}$, 2MgO , $11\text{B}_2\text{O}_3$, $20\text{H}_2\text{O}$. It is formed by the action of potassium chloride solution on pinnoite, $\text{MgB}_2\text{O}_4 \cdot 8\text{H}_2\text{O}$, and also when pinnoite is digested at 40° with a solution saturated in the cold with potassium chloride and boric acid. Its composition is similar to that of kaliborite, K_2O , 4MgO , $11\text{B}_2\text{O}_3$, $18\text{H}_2\text{O}$.

T. M. L.

3053. *Oceanic Salt Deposits. 38. Identity of Mamanite and Polyhalite. J. H. van't Hoff and G. L. Voerman.* (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 38. pp. 984-986, June 23, 1904.)—Mamanite was discovered by Goebel in 1866 in the Persian salt deposits at Maman, and was formulated as $\text{Ca}_3\text{K}_2\text{Mg}_2(\text{SO}_4)_6 \cdot 8\text{H}_2\text{O}$, whilst polyhalite has the formula $\text{Ca}_2\text{K}_2\text{Mg}(\text{SO}_4)_4 \cdot 2\text{H}_2\text{O}$. A sample was obtained from Goebel's collection and gave analyses similar to those of Goebel, with the exception of the potassium, which, determined by difference, appeared to be considerably higher. Attempts to prepare the mineral synthetically gave no indications of any compound intermediate between polyhalite and krugite, and the question of the identity of mamanite with polyhalite was finally settled by a direct determination of the potassium in the mineral; this gave a value identical with that for polyhalite, and finally excludes Goebel's formula for mamanite.

T. M. L.

3054. *Solution and Swelling of Colloids. K. Spiro.* (Beitr. Chem. Physiol. Path. 5. pp. 276-296, 1904.)—The swelling of gelatine is accelerated to a considerable extent by hydrogen and hydroxyl ions, and also by colloidal ferric hydroxide, even in presence of a substance like dextrose. With the latter alone the maximum swelling is obtained with a 8 per cent. solution, whilst with a 25 per cent. solution of dextrose no water is absorbed by the gelatine, and with still more concentrated dextrose solutions the

gelatine loses water and shrinks. Other substances, such as plates of agar, are not affected by colloids in the same way as gelatine. No close relationship exists between swelling and osmotic pressure, nor any hard and fast line between colloids and crystalloids, as certain colloids, egg albumin, for example, are capable of diffusing through plates of gelatine. In colloidal ferric hydroxide solution obtained by prolonged dialysis, which contains an appreciable proportion of chlorine, part of the substance is undoubtedly present in true solution, but the greater part is merely in suspension. Gelatin is much less affected by dialysed solutions than by the commercial solution. The formation of a colloidal solution seems to require the presence of a small amount of an electrolyte. T. H. P.

3055. *Complex Ions of Zinc and Cadmium.* H. Euler. (Ber. Deut. Chem. Gesell. 86. pp. 3400-3406, 1903.)—The solubility of zinc hydroxide in solutions of ammonia increases much more rapidly than the concentration of the ammonia. It is not found possible to calculate the dissociation constant K for the zinc-ammonia complex from the equation: $K = 4D[NH_3]_4/[Zn(NH_3)_4]^{2+}$, in which D represents the ionisation product, $Zn \times (OH)_2$. From the e.m.f. of the concentration cells, metal | hydroxide in ammonia | 0.05*N* sulphate | metal, the values of K are calculated to be 2.6×10^{-10} for zinc and 1.0×10^{-7} in the case of cadmium, the zinc-ammonia complex being thus some 100 times as stable as the cadmium-ammonia complex. In a similar way, K for $Zn(CN)_4$ is found to have the value 1.3×10^{-17} , and for $Cd(CN)_4$, 1.4×10^{-17} . Abegg's theory of valency [see Abstract No. 3021 (1904)] is discussed and criticised. T. H. P.

3056. *Mutual Relationships of Colloids in Solution.* W. Biltz. (Ber. Deut. Chem. Gesell. 87. pp. 1095-1116, 1904.)—Directions are given for the preparation of colloidal solutions of certain metals, sulphides, and oxides. When a current is passed through solutions of the hydrosols, all of them are attracted to the anode except the hydroxides which pass to the kathode; the hydroxyl compounds are hence positively charged, but the other colloids negatively. Oppositely charged hydrosols can precipitate one another in the absence of an electrolyte, the precipitate consisting of a gelatinous mass of the two hydrosols (adsorption compounds). Hydrosols with similar charges are only able to precipitate one another in presence of an electrolyte. Even with oppositely charged hydrosols, precipitation occurs only within certain limits of concentration. The increase in the power of precipitation of negatively charged colloids by salt solutions as the valency of the kation of the salt employed increases, agrees with the view that the precipitation is effected by colloidal metallic hydroxides in the aqueous salt solutions. This does not, however, apply to positively charged colloids. T. H. P.

3057. *Physical Properties of Solutions of Naphthalene in Various Organic Solvents.* C. Forch. (Boltzmann Festschrift, pp. 698-705, 1904.)—As solvents chloroform, toluene, carbon disulphide, and ether were employed. The value of the expression $(s - Q)/m$, where s and Q are the specific gravities of solution and solvent respectively, and m is the molecular concentration of the naphthalene, increases with decreasing concentration in all the solvents except chloroform, in which the reverse is the case. The specific gravity observed is always less than is to be expected from the specific gravities of

the solvent and of solid naphthalene (increase of the molecular volumes). A 82 per cent. solution of naphthalene in carbon disulphide is lighter than solid naphthalene. [See also Abstract No. 1973 (1904).] L. H. W.

3058. Decomposition of Trichloroacetic Acid and some of its Salts in Aqueous Solution. W. F. Timoféeff and L. D. Kobozeff. (Jurn. Russk. Fizik. Chimičesk. Obsčestva, 86. pp. 255-275, 1904.)—In the decomposition of trichloroacetic acid in aqueous solution into chloroform and carbon dioxide, the constant of the velocity of the reaction, which is of the first order, diminishes very considerably with increase of concentration of the acid and becomes almost zero for very concentrated solutions. The reaction thus proceeds at the expense of the active molecules of acid. The addition to the solution of trichloroacetic acid, of an equivalent quantity of hydrochloric acid causes a large decrease in the constant; thus, at 87°, K falls from 0.0054 to 0.0036 (with hydrochloric acid). In the case of salts of trichloroacetic acid, which undergoes a similar decomposition in aqueous solution, the water present must take part in the reaction in order to supply the hydrogen required for the formation of chloroform, and it is hence probable that water acts also in the decomposition of the acid. With potassium and sodium trichloroacetates, the velocity constant of decomposition falls rapidly as the reaction proceeds; that this is due to the accumulation of a salt of carbonic acid was shown by carrying out an experiment in presence of potassium carbonate, in which case K was found to be considerably less than before, but much more constant. To eliminate the influence of dissolved products of the reaction, the decomposition of barium trichloroacetate was studied, K in this case being found to be quite constant. The decomposition of trichloroacetic acid in aqueous solution is also a reaction of the first order, and the constant is here much greater than with the chloro-acid at the same temperature. According to the electrolytic dissociation theory, these decompositions would be expressed by the scheme: $\text{CCl}_3\text{COO} + \text{H}(\text{K}, \text{Na}, \text{ba}) + \text{H}_2\text{O} = \text{CHCl}_3 + \text{---}$, which would be an equation of the second (and, for the barium salt, perhaps the third) order; so that, like certain others, this reaction is not explained by the above theory. It is, however, possible that the reaction may take place in the three phases: (1) preliminary hydration of the CCl_3COO ions to $\text{CCl}_3\text{CO}(\text{OH})$; (2) decomposition of the latter at high temperatures into $\text{CHCl}_3 + \text{CO}_2 + \text{OH}$; and (3) combination of the OH and H^+ ions, and that only the second of these determines the velocity. T. H. P.

3059. Compounds of Aluminium Chloride with Oxygenated Organic Compounds. J. W. Walker and A. Spencer. (Chem. Soc., Journ. 85, and 86. pp. 1106-1110, July, 1904.)—The authors have prepared, in carbon bisulphide solution, compounds of aluminium chloride with a large number of organic substances, in order to see whether any proportionality exists between the number of oxygen atoms in the substance and the number of aluminium chloride molecules which it takes up. No such relation is found, and it appears that in some cases—for instance, methyl mandelate and acetic acid—the oxygen atom has more than four potential valencies. Cryoscopic measurements of the compound of aluminium chloride and *o*-nitrotoluene in the latter liquid as solvent indicate that *o*-nitrotoluene is dimorphous, one form melting at -4.25° and the other at -10° ; the molecular weight, of the compound is found to be between 650 and 700 (270.5 being the calculated number), which is diminished at higher concentrations. T. H. P.

3060. Constitution of Ammonium Compounds. J. C. Cain. (Manchester Lit. and Phil. Soc., Mem. 48. 14. pp. 1-11, July, 1904.)—In order to avoid the difficulties of the theory of ammonium compounds generally accepted at the present time, the author gives to them the constitutions, $\text{H}_2\text{N}:\text{ClH}$, $\text{H}_2\text{N}:\text{OH}_2$, in which the atom of chlorine is taken as trivalent and that of oxygen as tetravalent. Proofs have been given by several investigators of the trivalency of chlorine, while the tetravalency of oxygen is almost universally accepted. This theory is not in disaccord with the course of the electrolytic dissociation of these compounds, which may be expressed thus: $\text{H}_2\text{N}:\text{OH}_2 \rightarrow \text{H}_2\text{N} + \text{H}_2\text{O}$; $\text{H}_2\text{N}:\text{ClH} \rightarrow \text{H}_2\text{N} + \text{HCl}$ and $\text{HCl} = \text{H} + \text{Cl}$; in the latter case a complex ion $\text{NH}_3\cdot\text{H}$ is formed, and there is as yet no evidence that we can distinguish between this and the ion NH_4 . The formula $\text{H}_2\text{N}:\text{OH}_2$ is analogous to that for water, $\text{H}_2\text{O}:\text{OH}_2$, and to $\text{O}:\text{OH}_2$ and $\text{O}:\text{O}:\text{O}$. The formula for an ammonium salt, e.g., the sulphate, is to be written $\text{H}_2\text{N}:\text{OH}.\text{SO}_4.\text{OH}:\text{NH}_3$. As regards the compatibility of such a formula with the isomorphism existing between ammonium and potassium salts, the formation of potassium salts may be quite analogous with that of the ammonium salts, as is seen from the following representation of the successive stages in the formation of the sulphate: $2\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{K}.\text{HO}:\text{OH}.\text{SO}_4.\text{OH}:\text{OH}.\text{K} \rightarrow \text{H}.\text{HO}:\text{OK}.\text{SO}_4.\text{OK}:\text{OH}.\text{H}$, which, when water is split off, gives $\text{K}.\text{O}.\text{SO}_4.\text{O}.\text{K}$. The author applies his theory to the isomeric quaternary ammonium salts and certain other nitrogen compounds. T. H. P.

3061. Ionisation and Chemical Combination in Liquid Halogen Hydrides and Hydrogen Sulphide. J. W. Walker, D. McIntosh, and E. Archibald. (Chem. Soc., Journ. 85. and 86. pp. 1098-1105, July, 1904.)—A number of organic compounds dissolve in the liquefied halogen hydrides or hydrogen sulphide, giving well-conducting solutions. Most of the compounds examined are of the type $\text{R}(\text{OR})_n$, such as alcohols, ethers, acetals and esters, in which the formation of a compound between solvent and solute can only take place by means of potential valencies of the oxygen. The observed conductivities (in HCl at -100° , in HBr or H_2S at -80° , and in HI at -50°) in all cases indicate the formation of compounds, which is also shown by the deposition of a precipitate or the evolution of heat. In general, but not always, solutions in hydrogen chloride have the highest and those in hydrogen iodide the lowest conductivity. While Walden is of opinion that in these solutions the solute itself is resolved into ions, the authors hold the view that it is the compound of the solute with the solvent that is dissociated. [See also Abstract No. 2225 (1904).] T. H. P.

3062. Diminution of Velocity of Crystallisation Produced by Extraneous Substances. M. Padoa and D. Galeati. (Accad. Lincei, Atti, 18. pp. 107-111, July 17, 1904.)—To test Pickhardt's generalisation that equimolecular quantities of substances produce in a given solvent equal diminutions of the velocity of crystallisation, the authors have studied a large number of cases. By diminution of velocity is here meant the difference between the maximum velocity of the pure substance and the maximum of the mixture in question. The solvents used were α -naphthylamine, diphenylamine, benzil and benzophenone. The following results for naphthylamine as solvent illustrate the data obtained: Maximum kg. (velocity of crystallisation), 65.4; dissolved substances with their molecular weights—amyl alcohol (88), aniline (98), dibenzil (182), benzophenone (182), triphenylmethane (244), tribromophenol (381), lepidene (372), isobidesyl (390). For solutions containing 4 molecules

of each substance to 100 of naphthylamine we have the following diminutions of kg. respectively: 26.9, 34.4, 35.4, 31.2, 47.7, 45.4, 57.8, 58.5. The authors conclude as follows from their experiments: (1) According to Pickardt, the diminution of kg. is proportional to the square root of the concentration. An examination of the authors' data shows that this is rigidly correct in three cases, nearly correct in twelve cases, fairly correct in seven cases, and incorrect in ten cases. The general relationship is therefore more complex than Pickardt's formula presupposes. (2) Pickardt's generalisation as to molecular lowering of the kg. is shown by the present experiments to be quite untenable, and indeed, as the authors point out, has no theoretic basis, and is not fairly deducible even from Pickardt's own data.

D. H. J.

3083. Equilibrium between Chlorocamphor and Bromocamphor. M. Padoa. (Accad. Lincei, Atti, 18. pp. 31-34, July 17, 1904.)—The conditions for equilibrium between these two substances have already been studied [see Abstract No. 2359 (1904)] for *dextro* bromocamphor and *dextro* chlorocamphor. It was thought possible that different results (the formation of a racemic compound, for instance) might be obtained if *levo* bromocamphor were used instead of the *dextro* bromocamphor. However, the results were quite analogous to those given in the former paper, and there was no evidence of the formation of racemic compounds, but only of solid solutions (pseudoracemic compounds). "The fact that in this case we have mixed crystals (pseudoracemes) in place of true racemes is easily intelligible when we consider that we observe generally with camphor derivatives that optical antipodes tend generally to give solid solutions rather than racemic bodies."

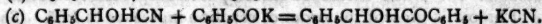
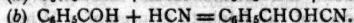
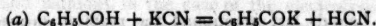
D. H. J.

3084. Nature of a Solution of Iodine in Potassium Iodide. C. H. Burgess and D. L. Chapman. (Chem. Soc., Journ. 85. and 86. pp. 1805-1817, Sept., 1904.)—From the work of Jakowkin and of Dawson it follows that the ionisation constants of potassium iodide and iodate are equal. By a consideration of their own observations and the chemical equations of the dissociation and ionisation of these salts, the authors show the ratio of the velocities of the I_2 and I ions to be 0.554. From conductivity measurements this ratio works out to a mean of 0.554, though the individual agreement of the experiments is not very close. To measure the changes of concentration in a solution of iodine in potassium iodide, a current was passed in series through a specially devised potassium iodate voltameter, and one constructed on the same principle but filled with potassium iodide solution.

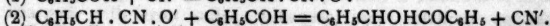
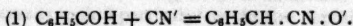
F. S.

3085. Catalysis by Means of Cyanogen Ions in the Formation of Benzoin. G. Bredig and E. Stern. (Zeitschr. Elektrochem. 10. pp. 582-586; Discussion, p. 587, Aug. 5, 1904. Communication from the Chem. Universitätslaborat. in Heidelberg. Report read before the 11 Hauptversamml. d. Deutsch. Bunsen Gesell., May 12-14, 1904, at Bonn.)—The authors have investigated the velocity of the condensation of benzaldehyde to benzoin under the catalytic influence of the cyanides of potassium and other metals. The progress of the reaction was measured by determining the amount of benzoin formed, by its oxidation to benzil by means of Fehling's solution. The temperature of experiment was 60° C., and the benzaldehyde was dissolved in 66 per cent. (by volume) alcohol. The reaction is of the second order with respect to the benzaldehyde. The velocity is directly proportional to the concentration of the CN^- ions, no matter whether the cyanides of potassium, sodium, or barium be used, except when the cyanide is present in large excess. This is also true

if part of the cyanogen ions are taken away by the addition of silver cyanide or mercuric cyanide. Cyanides such as mercuric cyanide and potassium ferrocyanide, also free hydrocyanic acid, have no condensing effect on benzaldehyde. Slight excess of free alkali is also without action. An alteration in the solvent from 88 to 80 per cent. alcohol increases the velocity about 40 per cent. In methyl alcohol solution the reaction proceeds about half as quickly as when ethyl alcohol is the solvent. The temperature coefficient is of the usual order. The order of the reaction is in agreement with the equations given by Knoevenhagel and Chalanay (Preuss. Akad. Wiss. 21. p. 1846, 1898), viz.—

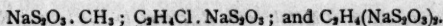


The equilibria (a) and (b) must be adjusted exceedingly quickly, and the reaction (c) takes place slowly and can be measured. The authors propose the following mechanism of the reaction—



Stage (1) proceeds very slowly in comparison with (2). These equations also explain why the velocity is proportional to the concentration of the CN' ions, and why ordinary mandelic nitrile, prepared from benzaldehyde and hydrocyanic acid, in the absence of alkalis, is not sufficient to give benzoin by reaction with benzaldehyde. In the discussion Bodenstein pointed out that the concentration of the CN' ions had been put directly proportional to the total amount of cyanide, even in 66 per cent. alcoholic solution; also that a direct measurement of the reaction velocity between mandelic nitrile and benzaldehyde in alcoholic solution would be of use. Bredig referred to the difficulty of the latter measurement, experiments in connection with which were not complete. [See also Abstract No. 211 (1904).] T. S. P.

3066. *Chemical Dynamics of the Reactions between Sodium Thiosulphate and Organic Halogen Compounds. Part I. Alkyl Haloids. A. Slator.* (Chem. Soc., Journ. 85. and 86. pp. 1286-1304, Sept., 1904.)—The author has investigated the velocity of interaction between sodium thiosulphate and the following haloids: Methyl iodide, ethyl iodide, methyl bromide, ethyl bromide, methyl chloride, ethylene iodide, ethylene bromide, ethylene bromoiodide, ethylene chloride, ethylene chloroiodide, and ethylene chlorobromide. These substances interact, forming compounds such as—



The velocity constants for methyl and ethyl iodide, bromide, and chloride, at 25°, are as follows:—

	I.	Br.	Cl.
CH_3	0.90 (8.0)	0.91 (8.1)	0.022 (8.2)
C_2H_5	0.050 (8.4)	0.081 (8.0)	Small.

The numbers enclosed within brackets are the temperature coefficients for a range of 10° (15-25°). As is evident, this temperature quotient is nearly the same in all cases. While in the five cases just mentioned, the reaction was found to be bimolecular, a variation in the order of reaction was met with in

the case of two of the ethylene derivatives, viz., ethylene chloriodide and chlorobromide. The following table gives the results with the ethylene haloids:—

Haloid.	Number of $\text{Na}_2\text{S}_2\text{O}_3$ Equivalents.	Nature of Reaction.	Velocity Constant.	Temperature Quotient for 10° .
$\text{C}_2\text{H}_4\text{I}_2$	2	Bimolecular	0.99 at 25° (a)	2.9
$\text{C}_2\text{H}_4\text{IBr}$	2	"	0.21 at 25° (a)	2.6
$\text{C}_2\text{H}_4\text{Br}_2$	1	"	0.49 at 50°	2.9
$\text{C}_2\text{H}_4\text{ICI}$	1	Unimolecular ¹	0.0040 at 50°	—
$\text{C}_2\text{H}_4\text{BrCl}$...	1	"	0.00150 at 50°	3.0

In the case of the two haloids last mentioned, the reaction proceeds as a unimolecular one when excess of thiosulphate is present. When a large excess of haloid is present the order of reaction increases to 1.85. The author explains the unimolecular cause of the reaction by assuming that the velocity measured is that of a change in the haloid into a more reactive form. Ethylene iodide is about three times as reactive as ethyl iodide; but ethylene and ethyl bromides react at approximately the same rate. [See also Abstract No. 2772 (1904).]

A. F.

3067. *Direct Measurement of Transportation Values.* R. B. Denison. (Zeitschr. Phys. Chem. 44. pp. 575–599, Aug. 4, 1903.)—Abegg and Gans have called attention to the fact that in Steele's method [see Abstract No. 946 (1904)] of determining transport values a correction must be made for cataphoresis or electric osmose, whereby the whole of the solution is moved in one or other direction along the tube. This correction raises the transport value for chlorine from 0.490 (Steele) or 0.495 (Masson) to 0.508, and thus makes chlorine more mobile than potassium. The present investigation has reference to the influence of cataphoresis on the transport numbers, and the differences between Steele's numbers in water and Masson's numbers in gelatine. The general results are: (1) That Steele's direct method gives correct values for simple salts of the alkali metals, excluding lithium, when corrected for cataphoresis. (2) Salts which form complexes or undergo hydrolysis give results differing from those obtained by Hittorf. (3) But the correctness of these numbers cannot be assumed until the effects of complex ions on the concentration of the intermediate electrolyte has been worked out. (4) The values in gelatine differ from those in water when the gelatine has set, but not otherwise; apart from this the concentration of the gelatine is without influence. (5) In solid gelatine the kation is retarded relatively to the anion. (6) The gelatine probably combines with certain salts to form a complex kation.

T. M. L.

3068. *Specific Action of Metals with Reference to Electrolytic Reduction and Oxidation.* A. Coehn. (Zeitschr. Elektrochem. 9. pp. 642–643; Discussion, pp. 643–647, Aug. 6, 1903. Report read before the 10 Hauptversammlung der deutsch. Bunsen Gesell., June 3–8, 1903, Berlin.)—The author gives a comprehensive account of the reducing action of electrolytic hydrogen set free on various metallic surfaces, particularly in conjunction with organic bodies. He states that the variable reduction potentials are closely connected with the facts found by Caspari, i.e., that hydrogen is evolved at a different e.m.f. on different metals. This does not only relate to hydrogen, but also to

¹ With excess of thiosulphate.

(a) Solvent: alcohol + water.

oxygen. Bright platinum requires 1.67 volts, copper oxide 1.48 volts, and nickel 1.35 volts; the latter metal in the spongy state only 1.28 volts. A very full discussion follows this paper.

O. J. S.

3069. Electrolytic Separation of Metals from Ores by means of Insoluble Anodes. **S. Laszczynski.** (Elektrochem. Zeitschr. 11. pp. 54-56, June, 1904.)—The novelty the inventor claims for his process consists essentially in surrounding the anode by means of a tightly-fitting cover, or sort of diaphragm. He claims that this contrivance counteracts the recombination of anions and kathions, in the case of the electrolysis of metallic solutions, and this ensures a very high-current efficiency. For instance, if a ferrous sulphate solution is electrolysed under the above conditions, the sulphuric acid set free at the anode forms a thin layer over same, and can be removed rapidly without coming into contact with the rest of the solution, and, at the same time, preventing the migration of iron ions. Rate of migration of ions and diffusion factors have naturally an important bearing upon the matter. The thickness of the covering stands in an inverse ratio to the current density. The process is to find particular use in the deposition of solutions of copper, heavily charged with iron salts. Likewise, zinc solutions containing manganese salts can be easily treated.

O. J. S.

3070. Anodic Pulverisation of Copper. **F. Fischer.** (Zeitschr. Elektrochem. 10. pp. 421-430, June 24, 1904. Physikal.-chemisches Institut der Universität, Freiburg.)—When the current density of a copper anode in sulphuric acid is increased, a transitory resistance is generated owing to the formation of a solid salt, which is deposited as soon as the velocity of its formation is greater than that of its solution. When the current is constant, the current density and potential are increased by this incrustation. So long as the anode does not become heated, oxygen is formed along with the cupric sulphate, but if heating of the anode takes place, increasing quantities of cuprous sulphate are produced with the cupric salt, while evolution of oxygen ceases. Reference has already been made to the pulverisation of the anode-coating [see Abstract No. 1564 (1904)], one effect of which is that at copper anodes with a high-current density, chromic acid and similar compounds are reduced.

T. H. P.

3071. Electrolytic Estimation of Minute Quantities of Arsenic. **H. J. S. Sand and J. E. Hackford.** (Chem. Soc., Journ. 85. and 86. pp. 1018-1028, July, 1904.)—The electrolytic reduction of arsenates to arsenites requires a large supertension of the kathode. The reaction is, therefore, most easily brought about in the presence of metals having this property, such as lead or zinc, or iron in the form of wire. Platinum, which has only a low supertension, proves inefficient even for very considerable concentrations of arsenates. The production of hydrogen arsenide from arsenites depends, however, on other influences besides supertension, for this can be accomplished with smaller concentrations of arsenious acid when platinum electrodes are employed than when copper ones having a much larger supertension are used; further, mercury electrodes, having the highest supertension of all metals, prove quite inefficient. A certain amount of supertension is required. For estimating small quantities of arsenic electrolytically, the authors recommend lead electrodes, which before first using should be thoroughly scraped and cleaned by immersion in boiling concentrated nitric

acid for 3 or 4 min., and subsequent washing in water. The influence of metallic salts in preventing the detection of small quantities of arsenic may be overcome by the simultaneous addition of a solution of lead acetate or zinc sulphate, in all cases except where mercury salts are present. T. H. P.

3072. Electrolytic Detection of Minute Quantities of Arsenic in Beer, Malt, and Foodstuffs. W. Thomson. (Manchester Lit. and Phil. Soc., Mem. 48. 17. pp. 1-14, July, 1904.)—A critical examination of the Inland Revenue Committee's recommendations on this subject. The method they propose is found to be less delicate than the Marsh-Berzelius process, the limit of sensibility being 1/300 grain of As_2O_3 per gall., working on 50 c.cm.; and the author, after experimenting with lead, copper, tin, aluminium, and plumbago as kathode, concludes that the substitution of a rod of pure zinc for the platinum kathode gives better results, the electrolytic method then equalling the Marsh-Berzelius in delicacy, and giving satisfactory mirrors with both arsenic trioxide and pentoxide. Reduction of the current from 5 to 8 amps. gives mirrors easier of comparison, the arsenic coming off more steadily, and being entirely removed in 40 min. The Committee's apparatus may be simplified by doing away with the bell glass, and grinding into a small porous jar a glass stopper with two holes, through one of which passes the zinc rod, while the other serves for the introduction of the liquid, and as an exit for hydrogen. The author's method of placing the liquid in a tube, into the bottom of which a thin glass rod is ground, is recommended as preventing any disturbance of the apparatus. The addition of amyl alcohol, proposed by the Committee to prevent frothing of beer, seriously interferes with the formation of mirrors, none being produced when 2 c.cm. amyl alcohol is added to 50 c.cm. of beer containing double the maximum permissible quantity of arsenic, and invert sugar is also shown to interfere slightly, though to a much less extent than amyl alcohol. W. H. Si.

3073. Preparation of Sodium and Calcium Hyposulphites by Electrolysis. A. R. Frank. (Zeitschr. Elektrochem. 10. pp. 450-452, July 8, 1904.)—A large porcelain cell with a platinum kathode, and filled with bisulphite lye, is placed in a glass vessel, the space between being filled with an alkaline, acid, or neutral anode liquid. The kathode cell is tightly covered, and portions of the cell contents are withdrawn and titrated for hyposulphite with potassium ferricyanide, using ferrous sulphate as an indicator. Sodium hyposulphite solution is readily formed by the electrolysis of a sodium bisulphite solution containing not more than a slight excess of free sulphurous acid. The solid salt could not be obtained. By electrolysis of a solution containing 40-60 gm. calcium bisulphite per litre, the hyposulphite separates out in fine silky needles after a few amp.-hours have been used. The salt contains 90-95 per cent. pure calcium hyposulphite, with small quantities of the monosulphite and thiosulphate; it cannot be kept without decomposing. [See Abstract No. 2875 (1904).] F. S.

3074. Behaviour of Telluric Acid on Electrolysis, and a New Modification of Colloidal Tellurium. A. Gutbier and F. Resenscheck. (Zeitschr. Anorg. Chem. 40. 2. pp. 264-267, July 8, 1904. Chem. Laboratorium der Universität, Erlangen, Jan., 1904.)—The first portion of the paper gives an account of unsuccessful attempts to electrolytically deposit tellurium in a coherent form for the purposes of electrolytic analysis. These experiments were not carried further owing to the publication by G. Pellini [see Abstract No. 2791 (1904)]

of a workable method for the electrolytic estimation of tellurium. On electrolyzing a solution of telluric acid containing KCN, the tellurium is reduced, and a brownish-violet colloidal solution obtained, which is found to be very stable if rapidly freed from the KCN by dialysis. It exhibits all the typical properties of a colloidal solution. F. G. D.

3075. Electrolysis of Glutaric Acid. L. Vanzetti. (Accad. Lincei, Atti, 18. pp. 112-120, July 17, 1904.)—The author has electrolysed glutaric acid, $\text{COOH} \cdot (\text{CH}_2)_3 \cdot \text{CH}_2 \cdot \text{COOH}$, to ascertain whether the residue $-\text{CH}_2 \cdot \text{CH}_2 \cdot \text{CH}_2-$ which separates (together with CO_2) at the positive electrode appears in the free state in the form of a cyclic compound (trimethylene). The current was from 2 to $2\frac{1}{2}$ amps. at 10 volts; the temperature was kept between -5° and $+5^\circ$ by a freezing-mixture. No trimethylene was obtained but, in its place, ordinary propylene. The author proposes to examine other dibasic acids (adipic, pimelic, and suberic) from the same point of view. D. H. J.

3076. Separation of Tin from Lead in Lead-Tin Alloys. L. Peetz. (Metallurgie, 1. pp. 281-297, July 22; and pp. 336-345, Aug. 22, 1904. From the Institut für Metallhüttenwesen und Elektrometallurgie, Aachen.)—These experiments aim at the removal of the lead from tin-lead alloys, by means of a bath of molten stannous chloride, or its double salts, based on the assumption that lead will set free a corresponding quantity of tin from molten stannous chloride. A very thorough investigation was made, with a great number of experiments, with the following results: (1) Stannous chloride forms double salts with potassium chloride and sodium chloride, provided the latter do not exceed the ratio of 1 of tin chloride to 2 of alkaline chloride. (2) At a dull-red heat considerable losses of tin take place, notwithstanding the presence of alkaline chlorides. (3) Alkaline earth chlorides do not form double salts. (4) The double salts are much more stable at high temperatures, but all the same decomposition, and thus tin losses, take place. (5) Pure SnCl_2 melts at 250°C ., and alkaline chlorides at a red heat, but the double salts already at 360° – 400°C . (6) SnCl_2 is decomposed by lead when heated together, with the deposition of an equivalent quantity of tin. This also takes place in the case of the double salts. (7) The rate of substitution increases with the rise of temperature. (8) In the case of lead-tin alloys the decomposition is not complete, and a state of equilibrium takes place. (9) The remainder of the lead cannot be eliminated from lead-tin alloys, and in the case of an alloy with 97 per cent. of tin, the partial removal of the lead requires too much expense. (10) The losses of tin render the process useless for practical purposes. Further experiments with alkaline metals and electrolytic separation, by means of a galvanic couple in which the alloy formed the anode, and PbO kathode, gave the following results: (a) The separation of tin and lead by means of oxidation of the tin through solid PbO , in an electrolyte of caustic alkali, with the formation of sodium stannate, is possible in about 8 days, at a temperature of 85°C . (b) If thick plates of the alloy are employed, the lead sponge must be removed, as the action is much retarded, and finally, PbO instead of tin may go into solution. (c) If plates of 1 mm. thickness are used, the process can be carried out without any losses of tin. Finally, the author remarks that only large scale experiments can establish the commercial value of the process. O. J. S.

3077. Electrolytic Estimation of Bismuth. A. Hollard and L. Bertiaux. (Comptes Rendus, 139. pp. 866-867, Aug. 1, 1904.)—Separation of Bismuth

and Copper.—The boiling solution of the metals as sulphates containing a fair excess of sulphuric acid is precipitated by excess of phosphoric acid. After 24 hours the precipitated bismuth phosphate is washed with dilute phosphoric acid (1 vol. acid of sp. gr. 1.71 in 20 vols. of water), and finally with a weak solution of ammonium hydrogen sulphide and potassium cyanide. The precipitate is dissolved in dilute nitric acid and converted into the pyrophosphate by evaporating with 12 c.cm. of sulphuric acid till abundant white fumes appear. It is diluted to 300 c.cm. and a current of 0.1 amp. passed for 24 hours; traces of copper in the deposit are determined colorimetrically. Separation of Bismuth and Lead.—The nitrates of these metals are evaporated with 12 c.cm. of sulphuric acid more than that required to unite with the metals. When abundant white fumes appear the liquid is diluted with 300 c.cm. of water, and 35 c.cm. of absolute alcohol are added. The liquid is electrolysed with a current of 0.1 amp. for 48 hours. The deposit of bismuth is free from lead, and small quantities of bismuth can be determined in the presence of large quantities of lead.

F. S.

3078. Measurement of Electrolytic Conductivity. L. Addicks. (Electrochem. Ind., N.Y. 2, pp. 306-307, Aug., 1904.)—The author, having a number of copper electrolytes to measure, tried various methods, and finally decided upon a fall of potential method. With a "wire" consisting of a tube of an acidified solution of copper sulphate, several points require attention. First, copper electrodes must be used throughout to avoid polarisation effects as far as possible and contamination of the electrolyte. Next, wherever current is led in by the copper electrode there will tend to be a gradually increasing concentration of the salt, and at the cathodes the opposite effect. These differences in concentration set up counter e.m.f.'s, and also cause ohmic changes. It is therefore necessary to use small currents. To avoid any evolution of gas at the electrodes the voltage should be kept below 1.3. A Weston voltmeter reading up to 1.5 volts was used, and the resistance in the potential circuit was about 150 ohms; and the current in the shunt circuit never exceeded 0.0009 amp. Great errors may be introduced if the potential electrodes are too near owing to the great fall of pressure in the region of the electrodes. A distance of 25 cm. was found satisfactory. A tube of 5 cm. diam. was used, and of a total length of 55 cm., the main electrodes being at the ends of the tube. The main current was 0.8 amp. To raise the temperature of the electrolyte a current of 5 amps. was used. The change from the low to the greater current was quickly made by a suitable switch. For practical work in everyday operations, such as watching the effect of growing impurities, the apparatus has proved rapid and sufficiently exact.

W. W. H. G.

3079. Stereochemical Hindrance in Electrochemical Reductions. K. Elbs. (Zeitschr. Elektrochem. 10, pp. 579-580; Discussion, pp. 580-582, Aug. 5, 1904. Report read before the 11 Hauptversamml. der Deutsch. Bunsen Gesell., May 12-14, at Bonn.)—On electrochemical reduction ana-nitro-*o*-toluquinoline gives good yields of the azoxy- and azo-derivatives, whereas ana-nitro-*p*-toluquinoline and ana-nitro-*m*-xyloquinoline yield only the amino-quinolines. This behaviour is independent of the kathode potential; the position of the nitrogen atom in the ring is the same in all three compounds, and therefore can have no effect. The author ascribes the difference in behaviour to stereochemical hindrance in the case of the two latter compounds; the nitroso and hydroxylamine compounds which are at first

produced cannot condense to form azoxy compounds owing to the steric hindrance of the neighbouring methyl group; they consequently suffer further reduction to aminoquinolines. In the discussion **Anschütz** referred to similar cases in the action of phosphorus oxychloride on salicylic acid and ortho-substituted salicylic acid; he explains the observed phenomena by a theory of secondary or subsidiary linkings of the atoms with each other. **Goldschmidt** objected to the term "stereochemical hindrance." In the case of the three nitrobenzoic acids the ratios of the velocities of reduction by means of sulphuretted hydrogen or alkalisulphhydrates are $o : m : p = 1 : 100 : 1000$, i.e., apparently a case of steric hindrance. When reduced with tin in alkaline solution the ortho and meta compounds react with equal velocities; para is a little quicker. With stannous chloride and hydrochloric acid the ortho isomer is more quickly reduced than the meta. In these cases the velocity of reduction depends not only on the position of the substituent, but also on the reducing agent, and consequently the theory of stereochemical hindrance will not hold. **W. Löb** pointed out that if the nitroso and hydroxylamine compounds reacted very slowly with each other in the case of the two latter compounds used by the author they would be reduced before any azoxy compound could be formed. [See also Abstract No. 195 (1901).] T. S. P.

3080. Electrode Changes and Potential-Formation with Minimum Ionic Concentrations. **R. Abegg.** (Zeitschr. Elektrochem. 10, pp. 607-609, Aug. 12, 1904.)—The deposition of metals takes place most readily from solutions of complex salts. Danneel has obtained convincing evidence that a primary separation takes place, which would condition a very rapid after-formation of metallic kathions from the complex anions. Solutions of complex mercury salts, in which the concentration of the Hg-ions is only about 10^{-10} , depolarise themselves completely, whilst solutions of non-complex mercury salts having the same Hg-concentration only do so imperfectly. The potential ionic concentration (Ionenreservoir) hence seems to be a reality. It appears indeed that, contrary to the investigations of several authors, the ions are formed infinitely quickly from the complexes. The conclusion that ions are present in cases of high velocity reaction rests on analogy, although this is strongly supported. From various observations it is probable that often the ionic concentration is so small as to be unrecognisable by the means at our command. According to Nernst the partial pressures of the hydrogen and oxygen in reduction and oxidation electrodes, like the ionic concentrations, are far below atomic dimensions. T. H. P.

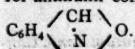
REFERENCES.

3081. Bismuth. **R. H. Adie.** (Cambridge Phil. Soc., Proc. 12, pp. 240-246, Oct., 1903.)—(i.) Bismuth and bismuth oxide after passing through the usual methods of purification still contain silicon and silica respectively. (ii.) Precipitation from acid solution in the form of basic salts or sulphide does not free bismuth from silicon, though the amount is reduced. (iii.) Distillation of the oxide in chlorine does remove the silica. (iv.) Since the presence of silicon increases the absorption of oxygen, Classen's number for the atomic weight of bismuth is probably more correct than Schneider's. This is further supported by Dumas' (1859) value of 210, which has hitherto been rejected, based on the ratio of Cl : Bi in bismuth chloride. T. M. L.

3082. Composition of the Surface Layers of Aqueous Amyl Alcohol. **Miss C. C. Benson.** (Journ. Phys. Chem. 7. pp. 532-536, Oct., 1903.)—On comparing the surface tensions of the foam of aqueous solutions of amyl alcohol with those of the solutions themselves, it is found that the concentration of the alcohol is greater in the foam than in the bulk of the liquid. With a solution containing 4 cm. of the alcohol per litre, the foam contains 4.12, 4.09, 4.13, and 4.23 cm. per litre. **T. H. P.**

3083. Action of Carbon Dioxide under Pressure on Metallic Phosphates. **A. Barillé.** (Comptes Rendus, 137. pp. 566-568, Oct. 12, 1903.)—The metallic phosphates may be divided into two classes according to their behaviour towards carbon dioxide under pressure and in presence of water: (1) those which combine with the gas to form a soluble carbophosphate, and (2) those which merely dissolve in the carbonic acid without undergoing change. Those of the first class are the phosphates of the alkalis and alkaline earths. **T. H. P.**

3084. Constitution and Optical Behaviour of the Nitrosoalkylurethanes and of Anthranil. **J. W. Brühl.** (Ber. Deut. Chem. Gesell. 36. pp. 3634-3645, 1903.)—The refractometric and spectrometric values for the nitrosoalkylurethanes are in agreement with the view that they are true nitrosoamines. The refractometric data for anthranil confirm the formula given by Bamberger for this compound, namely,



T. H. P.

3085. Gelatin rendered Insoluble by Chromium Salts. Action of Light on Gelatin in Presence of Chromates. **I. A. Lumière, L. Lumière, and A. Seyewetz.** (Bull. Soc. Chim. 29. 3. pp. 1077-1088, 1903.)—Solutions of gelatin are precipitated by many chromic salts, and the insolubility of the product in boiling water is greatest when the least acid salts, such as basic chromic sulphate, $\text{Cr}_2(\text{SO}_4)_3$, are used. The nature of the acid radicle of the salt employed is without influence on the precipitation. Chrome alum seems to be absorbed as such by gelatin, but as sulphuric acid can be washed out of the insoluble product by boiling water, it is probable that combination occurs between the gelatin and chromium sesquioxide. **T. H. P.**

3086. Atomic Weight of Indium. **L. M. Dennis and W. C. Geer.** (Ber. Deut. Chem. Gesell. 37. pp. 961-962, 1904.)—A method is described for separating indium from iron and aluminium chlorides, which is being used to purify indium for atomic weight determinations. Metallic indium can be deposited electrolytically from solutions of its chloride or nitrate in either pyridine, hydroxylamine, or formic acid. [See also next Abstract.] **L. H. W.**

3087. Indium. **A. Thiel.** (Zeitschr. Anorg. Chem. 40. 2. pp. 280-336, July 8, 1904. Habilitationsschrift. Chem. Institut der Universität, Münster, May, 1904.)—After describing the isolation of his material, the author gives the results of the determination of the atomic weight of indium by estimating the amount of chlorine in indium trichloride purified by sublimation in absence of air; four experiments gave the mean number 115.05 ± 0.02 ($O = 16$). Measurements are given for the electrical conductivity of indium chloride at varying dilutions and for the potential of indium towards indium chloride. **T. H. P.**

3088. International Atomic Weights. **F. W. Clarke.** (Chem. News, 90. p. 56, July 29, 1904.)—The author replies to the criticisms of Sakurai and Ikeda [Abstract No. 2395 (1904)] on the numbers published by the International Subcommittee on Atomic Weights. **T. H. P.**

3089. Variation of Weight on Chemical Change. **A. Lo Surdo.** (N. Cimento, 8. pp. 45-67, July, 1904.)—The author examines with very special precautions the change in weight brought about by the action of iron filings on a solution of copper sulphate, using the method of Landolt and Heydweiller. The sources of error are fully considered, and it is concluded that the slight variation in weight obtained is quite within the limits of experimental error, and that in this reaction no sensible change in weight occurs. W. H. St.

3090. Occurrence of Radium with Uranium. **R. J. Strutt.** (Nature, 70. p. 222, July 7, 1904.)—The mineral torbernite or copper uranite forms uniform, transparent, green, tetragonal crystals of the composition $\text{CuO}, 2\text{UO}_3, \text{P}_2\text{O}_5, 8\text{H}_2\text{O}$. It dissolves to a clear, green solution in sulphuric acid. This solution when boiled liberates the radium emanation at about the same rate as an equal weight of Joachimsthal pitchblende. The proportion of uranium is also about the same. Most radio-active minerals are complex in character, but in this case it is clear that if the radium has been produced from the other constituents of the mineral it must have come from the uranium. T. M. L.

3091. Metallic Passivity in relation to Time and Temperature. **W. A. Hollis.** (Cambridge Phil. Soc., Proc. 12. pp. 462-465, Aug., 1904.)—Preliminary notice on the passivity of iron, nickel, cobalt, and copper in fuming nitric acid. F. S.

3092. Formation of Toxic Products by Vegetable Enzymes. **C. A. Browne, Jr.** (Science, 20. pp. 179-181, Aug. 5, 1904.)—With regard to the rôle of reducing and oxidising enzymes in plants, the author believes, from observations made on sugar-canes, that when the plant is bruised, the oxidising enzyme accelerates the formation of a toxic substance which protects the plant against infection from micro-organisms. The poisoning of the plant itself by the toxic substance thus formed is prevented by the presence of the reducing enzymes, which hinder the diffusion of the toxic products beyond the points of formation and requirement. A. F.

3093. Influence of Radium Radiations on Atmospheric Oxidation in Presence of Iron. **H. J. H. Fenton.** (Chem. News, 90. p. 168, Sept. 30, 1904. Paper read before the British Association (Section B) at Cambridge, 1904.)—In certain cases the influence of radiations from radium bromide may act similarly to that of sunlight in oxidising certain hydroxy-compounds such as tartaric acid or glycol in presence of iron. T. H. P.

3094. Formation of Complex Ions. **H. Euler.** (Ber. Deut. Chem. Gesell. 37. pp. 1704-1714, 1904.)—From the values he obtains from the e.m.f. of concentration cells of the type, metal | metallic thiosulphate + sodium thiosulphate | metallic chloride or sulphate | metal, the author calculates the values of the dissociation constants for various complex ions formed by metals and sodium thiosulphate. The dissociation constants of the silver salts of various organic amino-compounds are also given. The cause of the formation of complex ions is discussed. T. H. P.

3095. Velocity of Inversion of Sugar (Saccharose) in Wine containing Gypsum. **G. Magnanini.** (Zeitschr. Elektrochem. 9. pp. 751-752, Sept. 3, 1903. Paper read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., June 3-8, 1903, at Berlin.)—Doubt has been expressed as to whether the gypsum in wine gives rise to neutral potassium sulphate by the reaction (1) $2\text{C}_6\text{H}_{12}\text{O}_6\text{K} + \text{CaSO}_4 = \text{CaC}_6\text{H}_6\text{O}_6 + \text{C}_6\text{H}_6\text{O}_6 + \text{K}_2\text{SO}_4$, or acid potassium sulphate according to the equation (2) $\text{C}_6\text{H}_{12}\text{O}_6\text{K} + \text{CaSO}_4 = \text{CaC}_6\text{H}_7\text{O}_6 + \text{KHSO}_4$. Investigation of the inversion of sugar by wine containing gypsum shows that at 70° this proceeds much more slowly than in solutions containing the proportion of acid potassium sulphate, which should be formed according to equation (2). Hence only neutral potassium sulphate is formed. T. H. P.

2906. Relation of the Thiocyanate Ion to the Halogen and Cyanogen Ions. Grossmann. (Zeitschr. Elektrochem. 9. pp. 736-737; Discussion, p. 737, Sept. 3, 1903. Paper read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., June 3-8, 1903, at Berlin.)—Like the chlorine, bromine, iodine, and cyanogen ions, the thiocyanate ion yields slightly-soluble silver, lead, thallium, and cuprous compounds. The power of these ions to form complexes varies, and is greatest with the cyanogen ion, next in order being the iodine, thiocyanate, bromine, and chlorine ions.

T. H. P.

2907. Electric Osmose and the Colloidal State. G. Bredig. (Zeitschr. Elektrochem. 9. pp. 738-739, Sept. 3, 1903. Paper read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., June 3-8, 1903, at Berlin.)—Electric osmose is the name given to the action of an electric current forcing a liquid unchanged through a diaphragm, quite independent of the electrolytic action. A similar action takes place with suspended matter, which is carried by the current to the anode or kathode. Colloidal solutions probably consist of a suspension of ultra-microscopic particles, as this would explain the analogy between the migration of colloids and electric osmose. Further, the coagulation of colloids by electrolytes is intimately connected with their migration to the electrodes, and both these phenomena are related to the deposition of suspended matter by electrolytes, and also to electro-capillary phenomena and the connection between composition and surface tension. [See also Abstract No. 429 (1904).]

T. H. P.

2908. Technical Applications of the Concentration of Solutions by Freezing. G. Monti. (Zeitschr. Elektrochem. 9. pp. 765-766; Discussion, p. 766, Sept. 10, 1903. Paper read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., June 3-8, 1903, at Berlin.)—Describes the concentration of wines and beers.

F. S.

2909. Researches on Phosphorus and Phosphoric Acids. H. Giran. (Annal. Chim. Phys. 30. pp. 203-288, Oct., 1903.)—The author gives firstly an account of work previously published [see Abstracts Nos. 1080, 1392, and 1393 (1903) and 673 (1904)]. He shows further that fresh solutions of the three varieties of phosphorus pentoxide contain almost exclusively metaphosphoric acid. The former then changes, as is shown by thermal measurements, into the pyro-acid, and the latter into orthophosphoric acid; the former of these changes is rapid and the latter slow. The author has measured the velocities at 12-19° of these reactions, which take place both simultaneously and successively, and complicate the kinetic aspect of the question. Thermal data are given for a large number of the reactions of phosphorus and its acids. The values given for the heats of formation of the three phosphoric acids are slightly higher (0.01 to 0.11 cal.) than those previously given by the author.

T. H. P.

3100. Complexes of Two Colloids of the Same or Opposite Electrical Sign. V. Henri, S. Lalou, A. Mayer, and G. Stodel. (Compt. rend. Soc. Biol. 55. pp. 1669-1671, and 1671-1673, 1903.)—On mixing two colloids of the same electrical sign, one of which is easily and the other difficultly precipitable by electrolytes, the mixture can be precipitated no more easily than the more persistent of the two. At first the stability of the mixture increases more slowly than the proportion of difficultly precipitable colloid, but afterwards increases very considerably. If a certain small or large quantity of a negative colloid, such as ferric hydroxide, is added to a positive colloid like silver, no precipitation occurs; but when the amount of negative colloid lies between certain limits, both are precipitated. Where the positive colloid predominates in the non-precipitated mixture, the complex is precipitable by acidic ions, and in the other case by metallic ions. In an electric field the complex generally moves in the same direction as the predominant component.

T. H. P.

3101. Coagulation of Colloidal Silicic Acid. N. Pappadà. (*Gazzetta Chim. Ital.* 33. pp. 272-276, 1903.)—The time required for the coagulation of colloidal silicic acid solutions is diminished by increasing the concentration of the coagulating salts, and varies with the nature of the latter. Acids, acid salts, and salts having acid reactions have only a slight, if any, coagulating power. Neutral salts coagulate with great rapidity, which increases with the molecular weight of the salt. Salts having an alkaline reaction have the most rapid coagulating action. T. H. P.

3102. Polymerisation of Orthomeric Liquids, especially Acetic Acid. A. J. Batschinski. (*Bull. Soc. Imp. Naturalistes Moscou*, pp. 188-189, 1903.)—The author has already [Abstract No. 2280 (1902)] devised a method for determining the degree of polymerisation of so-called orthomeric liquids, the vapours of which have the same degree of complexity, and he now applies this to acetic acid, using methyl formate and fluorobenzene as standard substances. The results are fairly concordant, but show slight differences due to the slight polymerisation of the standard substance or to the insufficient accuracy of the determination of its critical volume, as well as to the fact that the law of corresponding states is not absolutely true. The degree of polymerisation of acetic acid has the mean values: 1.7 at 100°, 1.6 at 150°, 1.5 at 200°, 1.4 at 250°, and 1.3 at 300°; these numbers are rather lower than those obtained by Ramsay and Shields, and lie, on the whole, between those found by other observers. T. H. P.

3103. Dissolved Substances. A. Vandenberghe. (*Bull. Acad. Roy. Belg.*, pp. 908-947, 1903.)—The author shows, by the boiling-point method, that the introduction of a new substance, whether associated or not, into the solution of an associated compound usually causes an increase in the association of the latter. The extent of the change varies with the solvent, the temperature and the concentrations of the dissolved compounds. The author hence gives up his former view, that an analogy exists between the dissociation of gases and that of dissolved substances. T. H. P.

3104. Inorganic Additive Compounds of Unsaturated Substances. J. Sand. (*Liebigs Ann. d. Chemie*, 329. pp. 135-166, 1903.)—The compounds formed by mercury salts with ethylene derivatives exhibit very varied behaviour towards different acids. Hydrochloric or hydrobromic acid or potassium cyanide decomposes them, regenerating an ethylene linking; thus, mercuryethanol bromide yields ethylene. Nitric and sulphuric acids, on the other hand, are without action. It seems as if mercury compounds of this class are only decomposed by reagents forming complex negative ions with the mercury, such, for example, as (HgCl_4) or $(\text{Hg}(\text{SCN})_4)$. The author suggests that, in these complex ions, the mercury atom is tetravalent, but that two of the valencies are of a different nature from the others. The addition of oxygen and nitric oxide to cobaltamines is considered to indicate the exhibition of "partial" or subsidiary valency in the molecules of oxygen and nitric oxide. T. H. P.

3105. Composition of Silver Compounds of Methyl- and Ethylamine in Solution. G. Bodländer and W. Eberlein. (*Ber. Deut. Chem. Gesell.* 36. pp. 3945-3951, 1903.)—The values obtained by the authors for the solubility of silver chloride and bromide in methylamine and ethylamine show that the product of the amount of dissolved silver haloid by its dissociation is proportional to the concentration of the free base. The authors demonstrate that the formulæ of the complex salts must be either AgB_2Cl or $\text{Ag}_2\text{B}_3\text{Cl}_3$ or $\text{Ag}_3\text{B}_4\text{Cl}_4$, &c., B being the base; and from the e.m.f. of concentration cells containing various quantities of the base and silver salt, it is found that the first of these formulæ is the correct one, the complexes being hence $\text{Ag}(\text{CH}_3\text{NH}_2)_2\text{X}$ and $\text{Ag}(\text{C}_2\text{H}_5\text{NH}_2)_2\text{X}$. [See also Abstract No. 2847 (1904).] T. H. P.

3106. Uranyl Double Nitrates. R. J. Meyer and F. Wendel. (Ber. Deut. Chem. Gesell. 86. pp. 4055-4058, 1908.)—The double nitrates of uranyl with potassium, ammonium, rubidium, caesium, and thallium crystallise well from nitric acid, and with the exception of the thallium salt, exhibit strong fluorescence. They are decomposed into their components by water, the thallium salt even by moist air. The composition is in all cases represented by the formula $R'UO_2(NO_3)_2$. Attempts to prepare similar salts of sodium and lithium, or of bivalent metals, failed.

3107. Dissociation of Lead Nitrate. L. Baekeland. (Amer. Chem. Soc., Journ. 26. pp. 891-899, 1904.)—In the reversible reaction, $Pb(NO_3)_2 \rightleftharpoons PbO + O + 2NO_2$, the pressure of the evolved gases at any particular temperature between 223° and 448° rises gradually to a maximum and then remains constant. This limiting or dissociation pressure of lead nitrate varies with the temperature, its values being: 6.2 mm. at 223°, 6.9 mm. at 230°, 11.8 mm. at 250°, 32.6 mm. at 274°, 78.4 mm. at 296°, 514.0 mm. at 357°, and 1,180.0 mm. at 448°. Under certain conditions the partially decomposed salt shows considerable decrease in its dissociation pressure, a yellow basic lead nitrate, $3PbO, 2N_2O_5$ being formed; in some cases also $3PbO, N_2O_5$ is formed. The introduction of variable amounts of oxygen and nitrogen peroxide into the lead nitrate tube, before heating, occasions a considerable fall in the dissociation pressure.

T. H. P.

3108. Chemical Equilibrium between Potassium Ferro- and Ferri-Cyanides in Presence of Alkali Hydroxides. M. Prud'homme. (Bull. Soc. Chim. 29. 3. pp. 1010-1012, 1903. Chem. News, 89. p. 254, May 27, 1904.)—By continued boiling of aqueous potassium ferricyanide with an alkali hydroxide it is transformed into the ferrocyanide, but this reduction is completed only in presence of a reducing agent, such as dextrose or indigotin. The velocity with which indigotin is oxidised when boiled with potassium ferricyanide and sodium hydroxide is proportional to the product of the concentrations of these two substances; when potassium ferrocyanide is also present the velocity of oxidation is inversely proportional to the concentration of the ferrocyanide. The author explains these observations by the existence of a state of equilibrium in the system: $K_3Fe_2Cy_{12} + 2KOH \rightleftharpoons 2K_4FeCy_6 + H_2O_2$.

T. H. P.

3109. Relative Stability of Carbonylferrocyanides towards Oxidising Agents. J. A. Muller. (Bull. Soc. Chim. 29. 3. pp. 1158-1161, 1903.)—Potassium carbonylferrocyanide is much more stable towards oxidising agents than the ferrocyanide. Thus it is not attacked by potassium persulphate, and only slightly so by potassium permanganate or ozone in presence of sulphuric acid, or by nitric acid.

T. H. P.

3110. Constitution of Ruthenium Potassium Nitroschloride in Aqueous Solution. S. C. Lind. (Amer. Chem. Soc., Journ. 25. pp. 928-932, 1903.)—Aqueous solutions of various concentrations of ruthenium potassium nitroschloride are quite stable, as it is found that electrical conductivity does not change in the course of two weeks. The values of the molecular conductivity are nearly the same as those of potassium platinichloride. The cryoscopic behaviour of the salt in water indicates that it is partially dissociated into three ions, van't Hoff's coefficient varying from 2.52 to 2.72 for 1/20- and 1/70-molar solutions. The values of the degree of dissociation given by the cryoscopic and conductivity measurements are in good accord and are also nearly equal to that obtained for potassium chloride. The ruthenium is present in the negative ion.

T. H. P.

3111. Theories of Indicators. J. Stieglitz. (Amer. Chem. Soc., Journ. 25. pp. 1112-1127, 1903.)—The author discusses the chromophoric theory of indicators, which he prefers to the ionisation theory. The constitutions of phenolphthalein and that of the amphoteric indicator, methyl orange, are considered. The sensitiveness of indicators is also referred to.

T. H. P.

3112. Alloys of Cerium and Lanthanum. W. Muthmann and H. Beck. (Liebig's Ann. d. Chemie, 331. pp. 46-57, 1904.)—The authors deal with the properties and preparation of alloys of cerium and lanthanum with aluminium (CeAl₃ and LaAl₃), and of cerium with magnesium, zinc, and mercury. Values for the heats of formation and of combustion are given, as well as specific gravities.

L. H. W.

3113. Liquid Hydrosol of Gold. A. Gutbier and F. Resenschek. (Zeitschr. Anorg. Chem. 39. 1. pp. 112-114, March 15, 1904. Chem. Laborat. der Kgl. Universität, Erlangen.)—On reducing gold chloride solutions by phenylhydrazine hydrochloride, the liquid hydrosol of gold obtained assumes different colours—red, reddish-violet, violet, bluish-violet, blue and even green—in different preparations. When dialysed, the solutions are found to be remarkably stable; they can be filtered and boiled, and on evaporation yield the hydrogel. In one and the same solution it is possible to obtain first the red, then the violet, and finally the blue gold salt. Concentrated gold solutions give a deep-green colouration and a rapidly-coagulating hydrosol, which appears as a fine metallic suspension.

T. H. P.

3114. Solubility and Decomposition of Double Salts in Water. E. Rimbach, with H. Burger and A. Grewe. (Ber. Deut. Chem. Gesell. 37. pp. 461-487, 1904.)—The decomposition of some uranyl double salts by water at different temperatures has been determined quantitatively, the salts examined being analogous to the cadmium double chlorides. The solubility was determined analytically at different temperatures. The compounds examined, especially the double nitrates (with K, NH₄, Rb and Cs) were fluorescent. The double sulphates with K and Rb, and the double nitrates with K, NH₄, and Rb, exhibited radio-activity.

L. H. W.

3115. Hardening of Barium Sulphate. P. Rohland. (Zeitschr. Anorg. Chem. 38. 3. pp. 311-318, Feb. 2, 1904. I. Chem. Inst. d. techn. Hochschule, Stuttgart.)—When made into a plastic mass with aqueous solutions of certain salts, e.g., AlCl₃, FeCl₃, MgCl₂, (and a substance *m* whose name the author has only confided to the Patent Office), then dried and fired, barium sulphate produces a mass whose hardness is 2.5 on Mohr's scale, and whose tensile strength and resistance to crushing the author will communicate to the Tonindustrie Zeitung. In this case the hardening process is intimately connected with the fact that the above-mentioned salts increase very greatly the solubility of barium sulphate. The phenomenon is regarded as a dehydration, and may be connected with a pyrochemical interaction between the foreign salt and the barium sulphate. It may also have something to do with the formation of a solid solution.

F. G. D.

3116. Hydrolysis of Ethyl Butyrate by Lipase. J. H. Castle, M. E. Johnson, and E. Elvove. (Amer. Chem. Soc., Journ. 31. pp. 521-550, 1904.)—Experiments with clear solutions of lipase, previously neutralised with caustic soda solution, showed that small amounts of free acid greatly inhibit the action of the enzyme while larger amounts destroy the ferment. Between 0° and 40° the rate of hydrolysis is increased by rise of temperature; the degree of hydrolysis is within certain limits independent of the concentration of the ethyl butyrate. Lipase appears to be a true catalytic agent in that it undergoes no permanent alteration during the hydrolysis of ethyl butyrate; its action more nearly resembles that of sodium hydroxide than hydrochloric acid.

L. H. W.

3117. Alloys of Aluminium with Bismuth and Magnesium. H. Pécheux. (Comptes Rendus, 138. pp. 1501-1503, June 13, 1904.)—The author has prepared four homogeneous alloys of bismuth and aluminium, containing 75, 85, 88, and 94 per cent. of aluminium respectively. Their densities and some of their chemical reactions are mentioned. They all decompose distilled water at ordinary temperatures.

F. R.

3118. Configuration of Maleic and Fumaric Stereoisomers and of the Corresponding Acetylene Compounds. G. Bruni. (Accad. Lincei, Atti, 13, pp. 626-632, June 4, 1904.)—Pfeiffer [see Abstract No. 2325 (1904)], assuming the existence of free or latent valencies, has proposed a modification of the theory of van't Hoff and Wislicenus on the stereoisomerism of the substances referred to in the title. The author of the present paper gives a *résumé* of his work on solid solutions to show how very well the study of solid solutions serves to assist the investigation of the constitution and stereometry of organic compounds. D. H. J.

3119. Stability of Potassium Permanganate and Ammonium Oxalate Solutions. W. M. Gardner and B. North. (Soc. Chem. Ind., Journ. 23, p. 599, June 15, 1904.)—Contrary to the generally accepted opinion, a solution of pure potassium permanganate retains its original strength, sufficiently nearly for all practical purposes, for at least twelve months, if pure water is used in its preparation and the solution is kept in a closely stoppered bottle; it need not be kept in the dark. Solutions of ammonium oxalate deteriorate at the rate of about 1 per cent. per fortnight, whilst in the dry state this salt and pure ferrous ammonium sulphate retain their original state undiminished for at least twelve months. T. H. P.

3120. Action of Maltase. C. Philoche. (Comptes Rendus, 138, pp. 1634-1636, June 20, 1904.)—Further experiments have shown that the activity of maltase (Taka diastase) preserves its activity at 39° during 38 hours when used to hydrolyse maltose. The action is hindered by the addition of glucose, but to a much less extent than the retardation by invert sugar of the rate of hydrolysis of cane-sugar by invertine. T. M. L.

3121. Alloys of Aluminium with Magnesium and Antimony. H. Pécheux. (Comptes Rendus, 138, pp. 1606-1607, June 20, 1904.)—The author has prepared four definite alloys of aluminium and antimony, viz., Sb + 30Al, Sb + 35Al, Sb + 38Al, Sb + 40Al, whose freezing-points are from 760° C. to 780° C. They are not brittle, but are fairly difficult to file. Their densities and some of their chemical reactions are given. The author's work on alloys of aluminium and magnesium confirms that of others. [See Abstract No. 515 (1902).] F. R.

3122. Decomposition of Salts of Selenium by Micro-organisms. B. Gosio. (Accad. Lincei, Atti, 13, pp. 642-645, June 4, 1904.)—The author finds that, like the alkaline tellurites, the selenites are reduced by many micro-organisms with the production of a red substance similar to that formed by the action of sulphurous acid on a selenite. The effect of a very large number of organisms has been studied, and except in a few doubtful cases the red colour was developed with all. The reaction is the direct result of bacterial life, dead organisms producing no colouration, and it is suggested as a method for the detection of living bacteria. W. H. St.

3123. Colloidal Metals of the Platinum Group. C. Paal and C. Amberger. (Ber. Deut. Chem. Gesell. 37, pp. 124-139, 1904.)—The author describes methods of preparing colloidal solutions of the platinum metals by means of protalbic and lysalbic acids. T. H. P.

3124. Ionisation and Chemical Combination. J. W. Walker. (Chem. Soc., Journ. 85, and 86, pp. 1082-1098, July, 1904.)—The view prevalent at the present time is that ionisation is a necessary preliminary to chemical action, but the author describes a number of conductivity measurements in different solutions, which seem to indicate that ionisation is a consequence, though not an absolutely necessary one, of chemical action. The formation of definite compounds between solvent and solute may be the result of potential valencies of certain atoms. The measurements made are described in detail. T. H. P.

3125. Distribution of a Non-dissociating Substance between Two Solvents. G. Jäger. (Boltzmann Festschrift, pp. 313-315, 1904.)—The author gives a proof, based on the kinetic theory, of Nernst's proposition that the ratio of the concentrations of a non-dissociating substance in two immiscible solvents is independent of the absolute quantity of the dissolved substance. T. H. P.

3126. Dissociation of Copper Sulphate and Decomposition of Copper Anodes. D. Tommasi. (Elektrochem. Zeitschr. 11. pp. 56-57, June, 1904.)—The author shows, by means of a number of experiments, that a neutral solution of copper sulphate on boiling in contact with the air, throws out considerable quantities of insoluble basic sulphate. O. J. S.

3127. On the Theory of the Blast-Furnace Process. R. Schenck. (Zeitschr. Elektrochem. 10. pp. 397-406, June 10, 1904. Report read before the Wanderversamml. des Rhein. Bezirksvereins Deutscher Chemiker zu Ruhrort, March 26, 1904.)—This paper deals with the various chemical reactions taking part in the reduction of iron in the blast furnace, mainly the reversibility of the reaction: $\text{FeO} + \text{CO} \rightleftharpoons \text{Fe} + \text{CO}_2$, and also $2\text{CO} \rightleftharpoons \text{C} + \text{CO}_2$. O. J. S.

3128. Copper and Nickel Salts of Some Amino-acids. G. Bruni and C. Fornara. (Accad. Lincei, Atti, 13. pp. 26-30, July 3, 1904.)—A description of the preparation, properties, and constitution of a number of copper and nickel salts of amino-acids, with a view to the determination of the physical constants later. D. H. J.

3129. Orthophosphoric Anilide and its Homologues. P. Lemoult. (Comptes Rendus, 139. pp. 206-208, July 18, 1904.)—In a paper chiefly of chemical interest the author, after describing a new method for the preparation of o-phosphoric anilide and its homologues ($\text{PO}(\text{NHR})_3$), points out that these compounds are the most stable of the numerous derivatives which the compounds of phosphorus give with the cyclic amines; they melt without decomposition, and are very stable towards alkalis. D. H. J.

3130. Density of Gold-Copper and Gold-Silver Alloys. C. Hoitsema. (Zeitschr. Anorg. Chem. 41. 1. pp. 63-67, Aug., 1904.)—A number of tables showing specific gravity of above alloys, and also formulæ for calculating same. O. J. S.

3131. Alloys of Zinc and Magnesium. O. Boudouard. (Comptes Rendus, 139. pp. 424-426, Aug. 16, 1904.)—Investigation of the freezing-point curves and other properties of the alloys of zinc and magnesium demonstrates the existence of the two definite compounds, Zn_2Mg and ZnMg_2 . T. H. P.

3132. Physical Properties of Liquids. S. Young. (Chem. News, 90. pp. 97-102, Aug. 26, 1904. Presidential Address to the Chemical Section of the British Association, Cambridge, 1904.)—The author gives a *résumé* of the work published on the relations between molecular volumes, boiling-points, &c., of liquids, and on the properties of mixed liquids. T. H. P.

3133. Electrolytic Reduction of Unsaturated Compounds. C. Marie. (Zeitschr. Elektrochem. 9. p. 633; with Discussion, Aug. 6, 1903. Paper read before the 10 Hauptversammlung der Deut. Bunsen Gesell. at Berlin, June 3-8, 1903.)—K. Elbs confirmed the author as to cinnamic acid which is easily reduced to phenylpropionic acid, but difficult to oxidise electrolytically. [See Abstract No. 1562 (1904).] H. B.

3134. Electrolytic Synthesis of Glutaric Acid. L. Vanzetti and A. Coppadoro. (Accad. Lincei, Atti, 12. pp. 209-215, Sept. 6, 1903.)—Using as kathode solution, molecular proportions of ethyl succinate and malonate dissolved in water, and as anode liquid a 30 per cent. aqueous potassium carbonate solution, the authors obtain as products of electrolysis with platinum electrodes, the ethyl esters of succinic, glutaric, and adipic acids, together with a small proportion of an unsaturated ester (? ethyl acrylate). T. H. P.

3135. Electrolytic Estimation of Manganese and its Separation from Iron and Zinc. G. P. Scholl. (Amer. Chem. Soc., Journ. 25. pp. 1045-1056, 1903.)—Manganese and iron may be estimated simultaneously by electrolysis the sulphate solution in the presence of ammonium acetate and formic acid. Zinc and manganese may be similarly separated in the presence of formic acid and ammonium formate. The iron or zinc are deposited as metals at the kathode, whilst the manganese is precipitated as peroxide on the anode. For working details the original paper must be referred to.

3136. Electrolytic Reduction of p-nitrotoluene in Hydrochloric Acid Solution in Presence of Formaldehyde. E. Goecke. (Zeitschr. Elektrochem. 9. pp. 470-473, June 4, 1908. From the Bonner chemisches Universitätsinstitut.)—When p-nitrotoluene is reduced electrolytically [see Löb, Abstract No. 678 (1898)] in presence of formaldehyde, a substance is formed to which various constitutions have been ascribed. The author has repeated the experiments, obtaining the substance both electrolytically and chemically by the aid of formaldehyde. He concludes that the product of reduction is trimethylene tritoluidin. A. F.

3137. Electrolytic Apparatus. F. M. Perkin. (Electro-Chemist, 3. pp. 22-27, July, 1903. Paper read before the Faraday Society, June 30, 1903.)—The kathode used by the author is in the form of a flag and is made of platinum gauze of 50-60 meshes to the sq. cm. fitted in a frame of platino-iridium (10 per cent. of iridium), roughened by a sand-blast. The anode is of platino-iridium wire which is forked so as to allow the kathode to pass between the two branches, each of which is bent into an S-shape. When rotation of the kathode is necessary, this may consist of a cylinder of platinum gauze fixed to a platinum wire which is joined to the turning apparatus. The latter consists of a gun-metal supporting arm through the drilled end of which passes a spindle carrying a small chuck used for holding the platinum wire of the kathode. Other forms are also depicted. T. H. P.

3138. Polarisation Capacity. F. Krüger. (Zeitschr. Phys. Chem. 45. pp. 1-74, Sept. 1, 1903. From the Institut für Physikalische Chemie, Univ. Göttingen.)—The subject matter of this paper has been dealt with in a previous Abstract. [See Abstract No. 198 (1904).] The present paper contains not only the theory but the full experimental details. F. G. D.

3139. Hydrogen Peroxide Ions and their Discharge Potential. G. Carrara and A. Bringhenti. (Gazzetta Chim. Ital. 33. 2. pp. 362-371, 1903.)—Measurements and curves are given of the p.d. required to generate a current in normal solutions of sulphuric acid containing hydrogen peroxide. With a large non-platinised platinum anode covered with oxygen, and a kathode consisting of a platinum point, an e.m.f. of 0.26 volt is necessary, whilst with a similar solution without the peroxide, 1.08 volts are required. When the large plate is used as kathode and the point as anode, the e.m.f. required to transmit a current is 0.39 volt in presence of hydrogen peroxide, and 0.60 without it. The conformation of the cathodic polarisation curves between e.m.f. and current point to the existence of hydrogen kathions alone, and confirm the view that hydrogen peroxide is a weak acid. The anions are probably the univalent $\cdot\text{HO}_2$ to which a discharge potential of 1.47 volts must be attributed. T. H. P.

3140. Quantitative Precipitation and Separation of Metals by Electrolysis. **H. Nissenson and H. Danneel.** (Zeitschr. Elektrochem. 9, pp. 760-764; Discussion, pp. 764-765, Sept. 10, 1903. Paper read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., June 3-8, 1903, at Berlin.)—Deals with lead, copper, tin, cobalt, and nickel, zinc and cadmium, also the form in which the metals separate, and cases of uneven deposit. **F. S.**

3141. Electrolytic Preparation of Alkali Selenates. **E. Müller.** (Ber. Deut. Chem. Gesell. 36, pp. 4262-4266, 1903.)—In the electrolysis of selenites, selenates are readily formed, but there is no formation of compounds analogous to the dithionates obtained during the electrolysis of sulphides. When a neutral solution of sodium selenite or selenate is electrolysed, a slight deposit of selenium is formed on the kathode, but it ceases after some time. When a faintly alkaline solution of sodium tellurite or tellurate is electrolysed, a considerable amount of reduction to tellurium takes place. **T. H. P.**

3142. Electrolytic Precipitation of Nickel from Phosphate Solutions. **W. T. Taggart.** (Amer. Chem. Soc., Journ., 25, pp. 1039-1041, 1903.)—The solution of nickel sulphate is precipitated with disodium hydrogen phosphate, the precipitate being redissolved in phosphoric acid and the solution electrolysed in a platinum dish, which serves as the kathode, while a flat platinum spiral is used as anode. The details as to strength of current, temperature, dilution, &c., are given, and it is found that nickel may be accurately estimated in this way. The separation of nickel from manganese, iron, aluminium, and chromium cannot be effected in this manner. **T. H. P.**

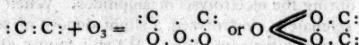
3143. Electrolytic Reduction of Nitric Acid in Metallic Nitrates to Ammonia. **W. H. Easton.** (Amer. Chem. Soc., Journ. 25, pp. 1042-1044, 1903.)—It was shown by Vortmann in 1880 that nitrates may be completely reduced to ammonia by electrolysis in presence of copper sulphate. In order that this reduction may take place, the following conditions must be adhered to: Amount of nitrate, about 0.5 gm.; copper sulphate, about 0.5 gm.; kathode of platinum or copper plate of 100 sq. cm. area; current, 0.15-3.0 amps.; time, $1\frac{1}{2}$ hours for 3 amps. and $8\frac{1}{2}$ hours for 0.15 amp.; voltage, 3-8; volume of solution, 150 c.cm.; sulphuric acid of specific gravity, 1.062, 30 c.cm. **T. H. P.**

3144. Hydrolysis of Maltose and of Dextrin by Dilute Acids. **W. A. Noyes, G. Crawford, C. H. Jumper, E. L. Flory, and R. B. Arnold.** (Amer. Chem. Soc., Journ. 26, pp. 266-280, 1904.)—The hydrolysis of maltose or dextrin with hydrochloric acid at first proceeds approximately according to the law of mass action, but ultimately becomes much slower than would be expected. The hydrolysis of maltose is more complete in a 2.4 per cent. solution than in one of 0.5 per cent. The rapidity of hydrolysis of dextrin is only about one-half that of maltose. **T. H. P.**

3145. Isomerism of the Diazoxides. **A. Hantzsch.** (Ber. Deut. Chem. Gesell. 37, pp. 1084-1087, 1904.)—The conclusion of Zawidzki [see Abstract No. 2408 (1904)], that an amphoteric electrolyte which has exceedingly feeble acid properties may nevertheless yield neutral salts with bases, has been welcomed by Bamberger as affording a possible explanation of the isomerism of the diazoxides, and has enabled him to suggest that the diazonium salts and the normal diazoxides may be regarded as derived from a common parent substance (the diazonium hydroxide), if the latter be regarded as an amphoteric electrolyte. As, however, Zawidzki's conclusions are not only in contradiction with the generally accepted laws of electrochemistry, but have been shown to be based on incomplete evidence [see Abstract No. 2410 (1904)], this view can no longer be justified. **T. M. L.**

3146. Silver Voltmeters. K. E. Guthe. (Phys. Rev. 19, pp. 138-153, Aug., 1904. Communication from the National Bureau of Standards.)—A detailed account of an investigation on this subject, the results of which have been already abstracted. [See Abstract No. 2380 (1904).] W. H. St.

3147. Oxidising Action of Ozone. C. D. Harries. (Ber. Deut. Chem. Gesell. 37, pp. 839-841, 1904.)—The action of ozone on unsaturated compounds in the absence of a solvent or in non-dissociating solvents consists in the addition of ozone at the double linking, with formation of ozonides :—



In presence of water these compounds undergo decomposition, yielding ketones or aldehydes and hydrogen peroxide. Possible a small quantity of water effects this decomposition, catalytic action taking place. The ozonides are mostly highly explosive, but some of them may be distilled undecomposed under reduced pressure.

T. H. P.

3148. Stereochemical Notes. Pasteur's Method. W. Meyerhoffer. (Ber. Deut. Chem. Gesell. 37, pp. 2604-2610, 1904.)—The full title of this paper is: "Pasteur's Method of Resolving by means of Active Compounds. Solubility of a Tartrate Compared with that of a Racemate." In the case of double salts, there are three temperature intervals corresponding with (1) the crystallisation from solution of the separate salts, (2) the crystallisation of the less soluble salt followed by the double salt, (3) crystallisation of the double salt only. Pasteur's method is only applicable within the limits of the first two intervals. The tension of the stable or labile tartrate mixture is double that of the single tartrate. The tension of a stable racemate may be smaller, or at most twice as great, whilst that of a labile racemate is more than twice as great as that of the tartrate. In an indifferent solvent, the tension curves have the same form as the solubility curves, and the figures given in the paper are applicable to either case.

T. M. L.

3149. Effect of One Associated Solvent on the Association of Another. H. C. Jones [and G. Murray]. (Boltzmann Festschrift, pp. 105-112, 1904.)—Results are given of determinations, by the freezing-point method, of the molecular weights of each of the three solvents, water, formic, and acetic acids, when dissolved up to moderately high concentrations in each of the other two. It is found that the association of the solute is less in every case than that of the same substance in the pure state, so that one associated liquid diminishes the association of another.

T. H. P.

3150. Relation between Solution Pressure and Heat of Ionisation of Metals. A. Korn and E. Strauss. (Boltzmann Festschrift, pp. 271-281, 1904.)—It is supposed by the authors that forces of repulsion between the particles of a metal are opposed by electrostatic forces between positively and negatively charged groups. The repulsive forces are favoured by immersing the metal in a solvent having a high dielectric constant, and the metal continues to pass into solution until the osmotic pressure reaches the value determined by the electrolytic solution pressure. Starting from these suppositions, it is concluded that the order of magnitude of the electrolytic solution pressures of the metals must be identical with the order of the values of the expression, $Q + \alpha n^2 m$, Q being the heat of ionisation, n the valency and m the atomic weight of the metal, and α a constant. Taking the values given by Ostwald for Q and putting $\alpha = 1/80$, the authors show that the above conclusion is verified for the series, Mg, Zn, Cd, Fe'', Ti, Co, Ni, Cu'', Hg', Ag, Pb does not occupy its proper place.

T. H. P.